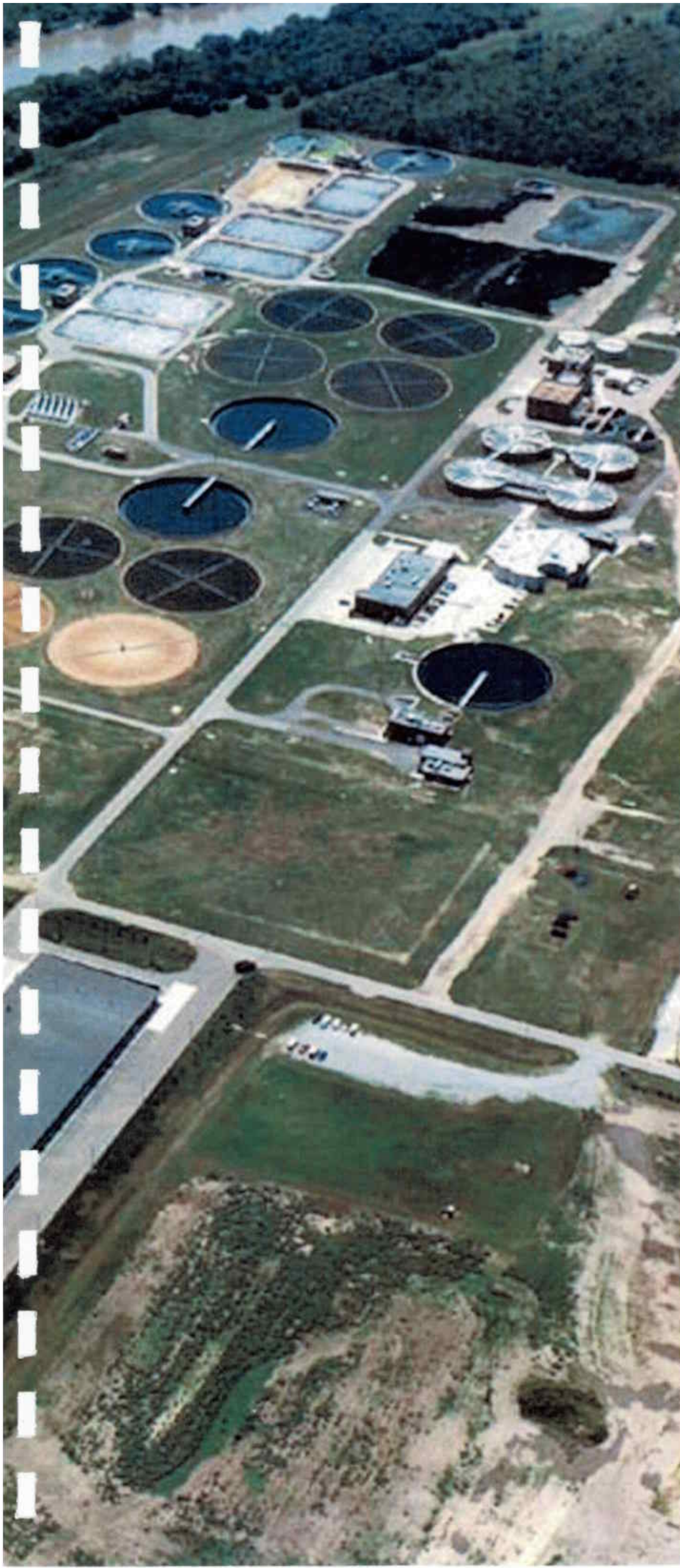

CITY OF WICHITA

Final Report

FEBRUARY 2009

WASTEWATER TREATMENT PLANT NO. 2

Nutrient Loading Evaluation

PEC Project No.
34-08198-0042

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WASTEWATER TREATMENT PLANT NO.2 NUTRIENT LOADING EVALUATION

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FINAL REPORT

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CHAPTER 1
INTRODUCTION

1.1 Background

The City of Wichita owns and operates several wastewater treatment plants (WWTPs). The focus of this project is on Wastewater Treatment Plant No.1 and Wastewater Treatment Plant No.2. The service area for Plant No.1 includes the central and eastern half of the City of Wichita, as well as the majority of the City's industries. The service area for Plant No.2 includes the flows that are pumped from Plant No.1 and those that flow by gravity from West Wichita. A portion of the current flow from West Wichita will be diverted to a new Mid-Continent Wastewater Treatment Plant located near the airport. The Mid-Continent WWTP is currently under construction and operations are planned to commence in 2010-2011.

City Staff have experienced difficulty with effluent pH and effluent ammonia at Plant No. 2. These issues are suspected to be linked to the influent pollutant levels received. Therefore, the City of Wichita retained Professional Engineering Consultants, P.A. to provide a review of the nutrient loading capacities at Plant No.2 and to recommend corrective action for addressing issues related to capacity constraints.

1.2 Objectives

The purposes of this project are:

- To evaluate operational data
- To model process and confirm modeled performance
- To perform a pollutant capacity evaluation
- To provide treatment alternatives utilizing the existing process
- To establish costs for the treatment alternatives
- To recommend modifications to the process
- To assist City Staff in developing parameters for pre-treatment surcharges and not to exceed limits for pollutants

CHAPTER 2
DATA COLLECTION AND ANALYSIS

2.1 Descriptions of Wastewater Treatment Plant No.1 and Plant No.2

Plant No.1 serves as the main lift station for the City of Wichita. The facility components include influent screening, lift pumps, a flow diversion structure, discharge pipe to WWTP No. 2, extraneous flow holding basins, and odor control equipment.

Plant No. 2 is the main wastewater treatment facility for the City of Wichita, processing the majority of the total flow from the City and discharging treated effluent into the Arkansas River. Plant No. 2 operates under the authority of the NPDES Permit issued by KDHE. The plant utilizes several different processes to treat wastewater to keep up with permitting regulations, and to meet the changing discharge standards imposed by the NPDES permit. Since the facility has been modified several times to comply with different regulations attributed to each modification, the capacities of each unit process will vary.

Plant No. 2 includes flows that are pumped from Plant No. 1 and those that flow by gravity from West Wichita. A portion of the current flow from West Wichita will be diverted to a new Mid Continent Treatment Plant located near the airport. This plant is to be designed as a skimming facility, taking all daily flows from the Cowskin Creek Interceptor up to and including 3.0 million gallons per day, with the capability of 6.0 MGD during peak flow conditions. The residual solids generated through the treatment of the wastewater will be returned to the interceptor and transported to Plant No. 2 for continued processing. The Mid-Continent Treatment Facility is under construction and expected to be operational in 2010-2011.

Plant No. 2 is the main wastewater treatment plant for the City of Wichita. The facility components include influent screening, lift pumps, grit removal, primary clarification, intermediate lift pumps, trickling filter biological treatment, intermediate settling basins, screw lift pumps, nitrification using activated sludge, final clarifiers, ultraviolet light disinfection, re-aeration and discharge to the Arkansas River. In addition to the unit processes that provide the treatment of the liquid portion of the wastewater, residual solids are processed at Plant No. 2 and are made up of primary sludge and waste activated sludge. These solids are pumped to the sludge distribution box, thickened in dissolved air floatation units, and pumped to the anaerobic digestion units, followed by dewatering with belt filter presses. These solids are then stored in a covered storage facility for ultimate disposal through application to crop land.

A process schematic of Plant No.1 and Plant No.2 is shown in Appendix A. A copy of the existing NPDES permit can be found in Appendix B.

2.2 Wastewater Treatment Plant No.1 and Plant No.2 Operational Data

Operational data from Plant No.1 and Plant No.2 were collected for 2006 and 2007. Data over the years of 2006 and 2007 are plotted in Appendix C. A statistical analysis was performed on the data and results are summarized in tables below.

TABLE 2-1.
WASTEWATER INFLUENT FLOW
(2006 to 2007)

	Plant 1 Flow (MGD)	Plant 2 Flow (MGD)	Total Flow (MGD)
Minimum	16.2	7.4	23.9
Average	23.0	10.2	33.1
Maximum	41.7	16.0	57.7
S.D.	2.7	0.7	3.1

S.D.: standard deviation

TABLE 2-2.
PLANT NO.1 INFLUENT DATA
(2006 to 2007)

	BOD (mg/L)	TSS (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)	TP (mg/L)	pH	Temp. (° C)
Minimum	142	55	11.5	0.0	3.2	6.04	9.4
Average	335	285	25.3	3.2	5.9	6.70	19.8
Maximum	538	1268	42.9	30.2	8.0	7.14	26.0
S.D.	61.5	116	4.3	4.1	1.0	0.18	3.5

TABLE 2-3.
PLANT NO.2 INFLUENT DATA
(2006 to 2007)

	BOD (mg/L)	TSS (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)	TP (mg/L)	pH	Temp. (° C)
Minimum	206	59	16.8	0.1	2.4	6.04	12.0
Average	272	231	25.7	3.2	6.2	6.91	20.4
Maximum	449	906	32.8	17.2	10.7	7.84	27.1
S.D.	30	73	2.8	3.2	1.5	0.15	2.9

TABLE 2-4.
PLANT NO.2 EFFLUENT DATA
(2006 to 2007)

	BOD (mg/L)	TSS (mg/L)	Ammonia (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	TKN (mg/L)	TP (mg/L)	pH	Temp. (° C)
Minimum	2.0	1.0	0.03	2.8	0.02	2.0	1.1	5.85	7.8
Average	6.7	6.6	0.34	24.7	0.20	2.4	4.1	6.68	19.7
Maximum	27.1	32.2	7.45	35.2	0.70	5.0	7.4	8.73	27.4
S.D.	3.4	4.7	0.78	5.3	0.21	0.9	1.1	0.18	4.4

2.3 Industrial Wastewater Data

Plant No.1 receives the majority of the City's industrial contribution. The industrial permitted categories of wastewater discharge are listed in Table 2-5. A complete list is shown in Appendix D.

TABLE 2-5.
INDUSTRIAL PERMITTED CATEGORIES
WASTEWATER FLOW DATA

Category	Average Daily Flow (GPD)	Permitted Total ADF (GPD)	% of Total ADF (%)
I	> 500K	5,500K	60.25
II	200K - 499K	1,000K	10.96
II	100K - 200K	1,504K	16.48
III	60K - 100K	522K	5.72
IV	30K - 60K	342K	3.74
V	< 30K	260K	2.85

Data provided by City (2008)

The City has established industrial pretreatment programs and monitors the industrial wastewater regularly. BOD, ammonia and total phosphorus (TP) influent data is summarized in Table 2-6.

TABLE 2-6.
INDUSTRIAL WASTEWATER NUTRIENT DATA

	BOD (mg/L)	Ammonia (mg/L)	TP (mg/L)	BOD (lbs/day*)	Ammonia (lbs/day*)	TP (lbs/day*)
Minimum	2	0.15	2.2	0	0	0
Average	1348	697	17.1	1791	705	22.7
Maximum	13800	4567	71.2	13089	4260	131.6
S.D.	1958	1218	16.4	2050	1209	34.7
* Mass loadings were calculated based on permitted flow rates BOD data from 2006 to 2007 Ammonia data from 2003 to 2008 TP data from 2007 to 2008						

2.4 Summary

Flow Capacity

Per data from 2005 Sanitary Sewer Master Plan Update Final Report, the capacity is listed below.

	Plant No.1	Plant No.2	Plant No.1 & No.2
Flow capacity	34 MGD [a]	30 MGD [b]	40 MGD [c]
Average day flow	23.0 MGD	10.2 MGD	33.1 MGD
Flow loading	67.6%	33.9%	82.8%

a The value was based on the capacity of the primary Clarifier (process through to primary clarifier).

b/c Since the Plant No.2 facility has been modified several times to comply with different regulations attributed to each modification, the capacities of each unit process will vary.

b The value was based on the capacity of the grit removal (process through to grit removal)

c The value was based on the capacity of the final clarifier (process through to Final clarifier)

Nutrient Loading

Plant No.1 was not designed for nutrient removal, so it is not expected that the facility at Plant No.1 would provide any nutrient reduction.

Plant No.2 was designed for ammonia, BOD and TSS removal. Therefore, it is expected that this facility will provide ammonia, BOD, and TSS reduction but not any significant reduction in nitrogen and phosphorus.

As previously mentioned, the capacities of each unit process at Plant No.2 vary, and nutrient removal is limited by the existing aeration process where the major removals of BOD and ammonia occur. Per the 2005 Sanitary Sewer Master Plan Update Final Report, the loading criteria for the aeration process are listed below.

Original Design	BOD entering the aeration process	50 mg/L
	Ammonia entering the aeration process	20 mg/L

Industrial Contributions

Total permitted industrial wastewater flow is 9.13 MGD. Table 2.7 shows the percentage of total flows and loads which are attributable to industry. Although 27% of the total flow is industrial, the BOD and nutrient contributions from industry are significantly lower.

TABLE 2-7.
INDUSTRIAL CONTRIBUTIONS AS A PERCENTAGE OF TOTAL LOADING

	Inflow to Plant No. 1	Total Inflow to Plant No. 2
Flow	39.7%	27.6%
Ammonia	14.6%	10.0%
TP	2.0%	1.4%
BOD	2.8%	2.1%

CHAPTER 3
WASTEWATER TREATMENT PROCESS MODELING

3.1 Model Descriptions

A wastewater treatment plant (WWTP) typically includes physical, chemical, and biological processes. Biological process systems are complex and involve a large number of interacting compounds and biological reactions. Computer process modeling and simulations can provide useful information to evaluate or predict performance in a WWTP, and this project utilized BioWin modeling software to simulate process performance for the Wichita WWTP No.1 and No.2.

BioWin was developed by EnvironSim Associates Ltd. BioWin is a Microsoft Windows-based simulator used world-wide in the analysis and design of wastewater treatment plants. Many different process units can be included to "build" a specific treatment plant configuration. It includes an integrated biological model for biological nutrient removal (BNR) activated sludge, fermenters, membrane bioreactor (MBR) and integrated fixed-film activated sludge (IFAS), aerobic digesters and anaerobic digesters.

Applications of BioWin can be used to:

- Model pH changes along the whole plant, in the liquid and the sludge line as well as sidestream processes
- Predict biological process performance
- Predict digester performance and biogas production and composition
- Perform a dynamic simulation over a selected period of time
- Evaluate metal addition for chemical phosphorus precipitation
- Evaluate methanol addition for denitrification

3.2 Model Calibration

A BioWin model configuration was set up for Plant No.1 and No.2 per the process schematic of WWTP Plant No.1 and Plant No.2. The model was calibrated with actual operational data before running other simulations. Operational data (as shown in Tables 2-1 to 2-4) was collected and an average value of each parameter was selected for model calibration. Per the 2005 Sanitary Sewer Master Plan Update Final Report, process basin dimensions and volume were used for model inputs.

The following assumptions were made for model calibrations.

Plant No.1 and Plant No.2

Influent alkalinity	200 mg/L
Influent ammonia/TKN ratio	0.75
Influent COD/BOD ratio	2.03
Influent temperature	20 °C
Influent D.O.	0 mg/L

To simplify the model configuration and setup, process trains, process basins or units were combined as one train or one unit. For an example, there are three activated sludge trains. Each train includes two (2) aeration basins and two (2) final clarifiers. Therefore, there are six (6) final clarifiers at WWTP No.2. For modeling purposes, one final clarifier was set up in the BioWin process configuration but its volume was set equal to the total volume of six (6) final clarifiers. Also, there are six (6) aeration basins at WWTP No.2. Each aeration basin has a stainless steel curtain approximately one third of the distance to the effluent weir. It is intended to increase the oxygen transfer efficiency. For modeling purposes, two aeration basins were set up in the BioWin process configuration. The first basin (AB1-1) has 30% of the total volume of six aeration basins and the second basin (AB1-2) has 70% of the total volume of six aeration basins.

The model was run under steady state conditions. It was assumed that all biological process units were online. The results of model calibrations are summarized in Table 3-1. A copy of the complete modeling results can be found in Appendix E. The model calibration was successfully completed and model results matched well with actual operational data.

TABLE 3-1.
RESULTS OF MODEL CALIBRATIONS

		Plant No.1 Influent		**Plant No.2 Influent**		**Plant No.2 Effluent**	
	Unit	**Actual Data**	**Model Data**	**Actual Data**	**Model Data**	**Actual Data**	**Model Data**
Flow	MGD	22.95	22.95	10.18	10.18	33.12	33.1
Alkalinity	mg/L		200		200	67.5	53.5
pH		6.71	6.71	6.91	6.91	6.68	6.33
Temp.	°C	19.8	20	20.4	20	19.7	20
BOD	mg/L	335	334	272	273	6.72	3.7
TSS	mg/L	285	287	231	232	6.6	6.8
NH3-N	mg/L	25.3	25.3	25.7	25.7	0.49	0.35
NO3-N	mg/L	3.24	3.24	3.18	3.18	24.7	19.7
NO2-N	mg/L		0		0	0.2	0.26
TKN	mg/L		33.7		34.3	2.42	2.62
TN	mg/L		36.94		37.5	27.3	22.6
TP	mg/L	5.94	5.94	6.16	6.16	4.05	3.77
COD	mg/L		680		555		41.9

3.3 Model Simulations

After the model calibration was completed, the model was run for four different scenarios at steady state conditions to evaluate process performance.

<u>Evaluate the impact of the influent ammonia levels on the effluent pH and alkalinity</u>

For this scenario, influent ammonia levels were increased until the effluent pH levels dropped below 6.0. Several assumptions were made:

- Influent ammonia levels are increased to the same value at WWTP Plant No.1 and No.2 for model simulations.
- All other parameters at WWTP Plant No.1 and No.2 are the same values as those for the model calibration.

The model was run under steady state conditions. The modeling results are summarized in Table 3-2, showing that the effluent pH drops below 6.0 when influent ammonia is higher than 29 mg/L. In fact, the model shows a significant drop in effluent alkalinity with only a 4 mg/l increase in influent ammonia.

TABLE 3-2.
IMPACT OF INFLUENT AMMONIA ON EFFLUENT PH AND ALKALINITY

Plant No.1 Influent Input Data			Plant No.2 Influent Input Data			Plant No.2 Effluent Model Outputs		
Ammonia (mg/L)	pH	Alk. (mg/L)	Ammonia (mg/L)	pH	Alk. (mg/L)	Ammonia (mg/L)	pH	Alk. (mg/L)
25.3	6.71	200	25.7	6.91	200	0.35	6.33	53.5
26	6.71	200	26	6.91	200	0.36	6.29	49.0
27	6.71	200	27	6.91	200	0.38	6.22	41.5
28	6.71	200	28	6.91	200	0.40	6.13	34.0
29	6.71	200	29	6.91	200	0.45	6.02	26.5
30	6.71	200	30	6.91	200	0.53	5.89	19.5

Influent data (Flow, Temp., BOD, TSS, Nitrate, TP) same as in Table 3-1

In order to keep the alkalinity from dropping so quickly, which in turn lowers the effluent pH, a means of increasing the alkalinity in the plant needs to happen. Ways to accomplish this are:

1. Control the influent ammonia. Not easy to do for the flow entering the plant, but possible from internal plant flows such as belt press filtrate or return flow from the DAF units. Possible scenarios:
    - Addition of calcium carbonate ahead of the primary clarifiers. Calcium carbonate could come from the water plant. Added ahead of the primaries would create alkalinity through the plant plus create a more concentrated sludge to the digesters. This in turn would create a higher solids concentration coming from the digester, leading to less DAF return and less filtrate.
    - Treatment of filtrate following the filtrate tanks to reduce ammonia contribution.

<u>Develop nutrient (ammonia, TKN, TN, TP) loading balance in system</u>

For this scenario, the model was run under steady state calibration conditions. The modeling results are summarized in Table 3-3. They show that the current WWTP processes do a good job of ammonia removal, but not so good at total nitrogen and phosphorus. Basically, the plant operates as it was intended to, since it is designed for ammonia reduction and not biological nutrient removal.

TABLE 3-3.
NUTRIENT LOADING

Flow (MGD)	Ammonia (mg/L)	TKN (mg/L)	TN (mg/L)	TP (mg/L)	Ammonia (lbs/day)	TKN (lbs/day)	TN (lbs/day)	TP (lbs/day)
Plant No.1 Influent								
23.0	25.3	33.7	36.9	5.94	4837	6450	7070	1137
Plant No.2 Influent								
10.2	25.7	34.3	37.5	6.16	2185	2912	3182	523
Plant No.1 and Plant No.2 Influent								
33.1	25.4	33.9	37.1	6.01	7021	9362	10253	1660
Plant No.2 Effluent								
33.1	0.35	2.62	22.6	3.77	97	724	6238	1041
% Remaining (as compared to Influent)					1.4%	7.7%	60.8%	62.7%
% Removal (as compared to Influent)					98.6%	92.3%	39.2%	37.3%
Plant No.2 DAF Return Flow								
0.57	10.8	230	243	89	51	1096	1157	424
% Remaining (as compared to Influent)					0.7%	11.7%	11.3%	25.5%
Plant No.2 BFP Filtrate Return Flow								
0.12	502	622	622	604	503	622	622	604
% Remaining (as compared to Influent)					7.2%	6.6%	6.1%	36.4%

Data from BioWin model calibration

It is possible, however, to reduce total nitrogen and phosphorus to a point by reducing the sludge age in the activated sludge portion of the plant. Microorganisms require nutrients to make new cells, and a younger sludge age means faster production of microorganisms. This would lead to a higher uptake of nutrients.

The potential downside of this is a lower sludge age means less solids and more water being wasted to the DAF units. Though the polymer will work well at the DAF, the issue is more return volume.

<u>Evaluate the impact of recycle rates of Trickling Filters on BOD loading in Aeration Basins and Plant Effluent</u>

For this scenario, recycle rates of trickling filters were varied from 50% to 100%. Several assumptions were made:

- The recycle rates of trickling filters are the only parameter to be changed at WWTP Plant No.1 and No.2 for model simulations.
- All other parameters at WWTP Plant No.1 and No.2 are the same values as those for the model calibration.

The model was run under steady state conditions. The modeling results are summarized in Table 3-4. As the recycle rates of the trickling filters were increased, the following results were noted.

TABLE 3-4.
IMPACT OF RECYCLE RATES ON BOD

Trickling Filter Recycle Rate (%)	Aeration Basin BOD Loading (mg/L)	Aeration Basin BOD Removal (%)	Plant No.2 Effluent BOD (mg/L)
101.2	95.0	98.1	3.70
91.1	96.0	98.0	3.74
81.0	97.1	97.9	3.79
70.8	98.3	97.7	3.84
60.7	99.6	97.6	3.89
50.6	101.0	97.4	3.95

Influent data (Flow, Temp., BOD, TSS, Nitrate, TP) same as in Table 3-1

As Table 3-4 shows, BOD loading does not increase much by cutting the recycle rate in half. The same holds true for the effluent BOD. As a result, it is recommended that the trickling filter return be cut back to 50%. The cost savings in pumping will likely outweigh a slight BOD increase which will probably be removed by the activated sludge process anyway.

<u>Evaluate the impact of Solids Retention Time (SRT) of Aeration Basins on Plant Effluent BOD and WAS production</u>

For this scenario, SRTs of aeration basins were varied from 6 to 18 days. Several assumptions were made:

- The SRT rates of aeration basins are the only parameter to be changed at WWTP Plant No.1 and No.2 for model simulations. Per the model setup, a SRT value is a calculated number from modeling results. To achieve that purpose, RAS rates are varied in the model in order to obtain different SRTs.
- All other parameters at WWTP Plant No.1 and No.2 are the same values as those for the model calibration.

The model was run under steady state conditions. The modeling results are summarized in Table 3-5. The findings, as the SRTs of the aeration basins decreased, are listed below.

TABLE 3-5.
IMPACT OF SRT ON BOD AND WAS

Aeration Basin SRT (days)	Aeration Basin BOD Loading (mg/L)	Aeration Basin MLSS (mg/L)	Aeration Basin BOD Removal (%)	Effluent BOD (mg/L)	WAS Conc. (%)	WAS Conc. (lbs/day)
18.3	96.6	1488	97.8	4.3	0.77	14850
14.2	95.8	1235	97.9	4.0	0.64	16600
10.8	95.0	1009	98.1	3.7	0.52	18360
9.8	94.7	938	98.1	3.6	0.49	19090
7.6	94.3	841	98.2	3.4	0.44	19670
6.1	93.5	642	98.4	3.1	0.33	21640

Influent data (Flow, Temp., BOD, TSS, Nitrate, TP) same as in Table 3-1

As mentioned earlier, a lower sludge age (SRT) will result in more water being wasted to the DAF units. However, an SRT somewhere around 9 days would not create a dramatic increase in waste volume. It would also reduce the slight BOD increase created if the trickling filter recycle were cut back to 50%, and would realize a decrease in total nitrogen and phosphorus by having a younger sludge.

CHAPTER 4
PROCESS IMPROVEMENTS

4.1 Process Improvements

Alkalinity Adjustments

The alkalinity in wastewater helps to resist changes in pH, and is measured as the sum of hydroxides, carbonates and bicarbonates. Adequate alkalinity is important for the nitrification process; however, the consumption of alkalinity during nitrification can result in inadequate alkalinity in the process. Generally, an alkalinity of at least 50 mg/L as $CaCO_3$ in the process is desired.

Table 4.1 shows the amount of alkalinity required under varying influent ammonia concentrations to provide a minimum alkalinity of 50 mg/L as $CaCO_3$. This is a simplified calculation, only reflecting the nitrification process. The following assumptions were also made:

- Influent alkalinity is 200 mg/L as $CaCO_3$.
- Effluent ammonia is 1.5 mg/L as N (permit condition during the month of July).
- Every gram of converted ammonia-nitrogen requires approximately 7.14 grams of alkalinity (as $CaCO_3$)

TABLE 4.1
ALKALINITY CONSUMPTION

Influent Ammonia-Nitrogen (mg/L)	Effluent Ammonia-Nitrogen (mg/L)	Nitrification Alkalinity Consumed (mg/L)	Total Alkalinity Needed (mg/L)	Additional Alkalinity Required (mg/L)
25.4	1.5	187.9	237.9	37.9
26.0	1.5	192.4	242.4	42.4
27.0	1.5	200.3	250.3	50.3
28.0	1.5	208.1	258.1	58.1
29.0	1.5	216.0	266.0	66.0
30.0	1.5	223.8	273.8	73.8

Two options for chemically increasing alkalinity are discussed below:

1. Explore the option of using the existing water treatment plant lime softening residual (containing calcium carbonate) as a source of alkalinity. This would require a new collection system at the water treatment plant and coordination of transportation to one of the wastewater facilities. Additionally, it would not be available on a continuous basis.

   This option was mentioned in Chapter 3 as a possibility to increase the solids concentration in the primary clarifiers which will provide a thicker sludge and a boost of alkalinity to the digesters in addition to the plant process.

2. The chemical addition of lime ($Ca(OH)_2$) or caustic soda (NaOH) was reviewed. Table 4.2 shows the pounds (or gallons) per day of chemical that would be required to achieve an effluent ammonia-nitrogen of 1.5 mg/L and an effluent alkalinity of 50 mg/L as $CaCO_3$ for the average plant flow of 33.13 MGD, under varying influent ammonia concentrations.

TABLE 4.2
ALKALINITY ADDITION

Influent Ammonia-Nitrogen (mg/L)	Caustic to Add (NaOH – 30% solution)		Lime to Add ($Ca(OH)_2$) (ppd)
	(ppd)	(gpd)	
25.4	27,918	2,574	7,747
26.0	31,258	2,882	8,674
27.0	37,045	3,416	10,280
28.0	42,832	3,949	11,886
29.0	48,618	4,483	13,492
30.0	54,405	5,017	15,097

Caustic soda is usually available as a liquid solution, delivered in drums or totes. Lime is typically delivered as a solid in bags or barrels. A liquid feed system would include the solution storage tanks, transfer pumps, and day tanks in addition to a chemical feed pump. A dry chemical feed system would require a storage hopper, chemical feeder, and day tank, prior to the distribution system. The chemical feed could be located either at Plant No. 1 or at the screw pumps at Plant No. 2, depending upon space and accessibility for the system and chemical storage.

With site and building modifications, the initial estimate for the capital investment in a new caustic soda feed system is $500,000, and for a hydrated lime feed system it is $600,000. Table 4.3 illustrates potential daily chemical costs for the above influent conditions.

TABLE 4.3
DAILY CHEMICAL COSTS

Influent Ammonia-Nitrogen (mg/L)	Caustic (NaOH – 30% solution) ($1.50/gal)	Lime ($Ca(OH)_2$) ($70/ton)
25.4	$3,860	$270
26.0	$4,320	$300
27.0	$5,120	$360
28.0	$5,920	$420
29.0	$6,730	$470
30.0	$7,530	$530

BOD Loading to Aeration Basins

Per the 2005 Sanitary Sewer Master Plan Update Final Report, the capacity of the aeration process is listed below.

Original Design	BOD entering the Aeration Process	50 mg/L

From Table 3-4, if the trickling filter recirculation rate is at 100%, the BOD to the aeration basin would be 95 mg/l. If the recirculation rate were reduced to 50%, the aeration basin would see a BOD of approximately 100 mg/l. Both values are over the rated design from the 2005 Master Plan.

Though the aeration basin appears to be loaded above design, low BOD numbers are being produced which tend to indicate the original design number may be low. Microorganisms are busy lowering the BOD, and nitrification is taking place. The nitrification process converts ammonia to nitrate, consuming alkalinity. This may potentially cause deficits of pH and alkalinity for the process if the levels of the influent alkalinity are lower than process demands. In addition, the metabolism of microorganisms for BOD conversion is faster than those of nitrifying bacteria for nitrification. In other words, the available oxygen would be utilized first for BOD conversion, and the remaining oxygen would be supplied for nitrification. This may cause an incomplete nitrification process, occasionally resulting in elevated effluent ammonia or lower levels of pH and alkalinity. In addition, excess BOD removal would yield additional sludge production. This would increase solids loading to the solids handling processes and, consequently, greater operational challenges.

Alkalinity can be recovered from the denitrification process, whereby nitrate is converted to nitrite and then nitrogen. However, Plant No.2 does not have denitrification processes and the recovery of alkalinity is not possible, so other sources must be explored.

It is recommended to monitor the BOD, pH and alkalinity into the aeration basins. This will provide a wealth of information to assist in optimization of operation of the activated sludge process and also provide better model predictions.

Nutrient Loadings from Solids Handling Process

The existing Plant No.2 has limited reductions of TN and TP. Sidestream flow (DAF return and belt filter press filtrate return) contributes 1% to 7% of ammonia, 6% to 12% of TKN, 6% to 11% TN and 25% to 36% of TP to the plant influent loadings.

Nutrient loadings from the return flow in sludge thickening (DAF) and digestion (anaerobic digesters) should be monitored to provide more information to assist in optimization of operation. This data can also provide better model predictions. Process optimizations at DAF and anaerobic digesters would also reduce nutrient loadings back to the plant.

Consideration has been given to transferring sludge from other WWTPs such as Valley Center WWTP and Four Mile Creek WWTP to Plant No.2 for solids handling. Sludge trucks would come in on different days and at various times throughout the day. Because a more stabilized or consistent quality of sludge improves process control and operations, a receiving tank ahead of DAF tanks is suggested, with transfer pumps to deliver the received sludge to the DAF process.

4.2 Summary

Findings

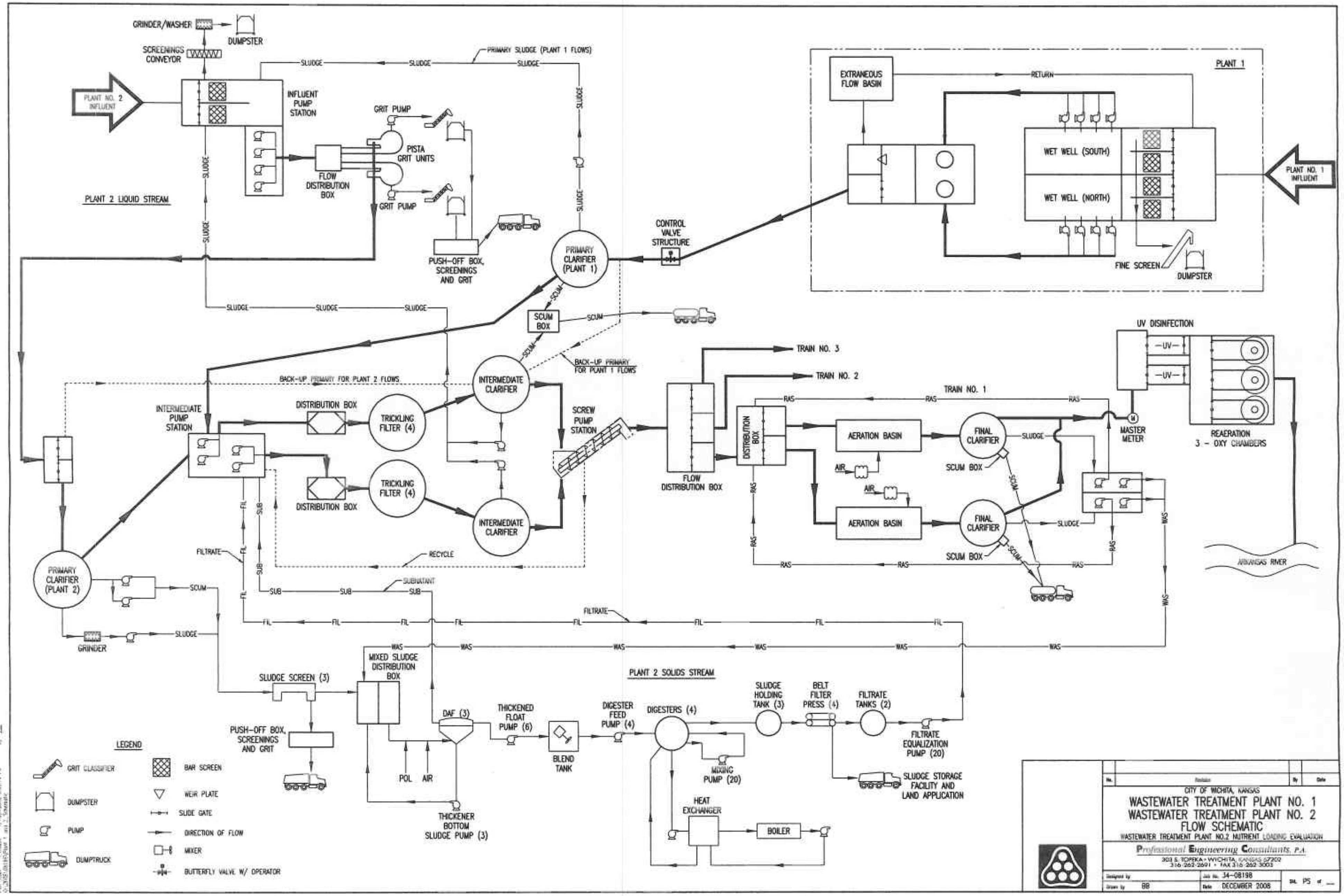
- The current plant performance is excellent and treated effluent meets permit requirements.
- Process modeling is a useful tool for evaluating process performance and assisting operations.
- Model results indicate alkalinity may be a deficit if the influent ammonia is higher than 29 mg/L.
- Current BOD loadings to the aeration basins are higher than original design capacity.
- Sidestream flows contribute 6% to 11% TN and 25% to 36% of TP to the plant influent loadings.

Recommendations

- Add a chemical feed system and storage for lime addition, to ensure process stability under changing future influent conditions.
- Establish additional monitoring to provide a baseline for process optimization and possible operational changes:
    - Monitor BOD, pH and alkalinity into the aeration basins.
    - Monitor nutrient loadings from the return flow in sludge thickening and digestion.

Conclusions

A balance needs to be found in the system to make all components of the process work in harmony. Knowing how each piece of the process is affecting the other will allow potential changes to be made. Gathering data through testing will lead to the ability to model each aspect of the process, thereby achieving the balance in the process.


PLANT 2 LIQUID STREAM
PLANT NO. 2 INFLUENT
GRINDER/WASHER
DUMPSTER
SCREENINGS CONVEYOR
INFLUENT PUMP STATION
FLOW DISTRIBUTION BOX
GRIT PUMP
PISTA GRIT UNITS
PUSH-OFF BOX, SCREENINGS AND GRIT
PRIMARY SLUDGE (PLANT 1 FLOWS)
SLUDGE
PRIMARY CLARIFIER (PLANT 1)
CONTROL VALVE STRUCTURE
SCUM BOX
SCUM
BACK-UP PRIMARY FOR PLANT 1 FLOWS
BACK-UP PRIMARY FOR PLANT 2 FLOWS
INTERMEDIATE PUMP STATION
DISTRIBUTION BOX
TRICKLING FILTER (4)
INTERMEDIATE CLARIFIER
SCREW PUMP STATION
RECYCLE
FILTRATE
SUBNATANT
PRIMARY CLARIFIER (PLANT 2)
GRINDER
PLANT 1
EXTRANEOUS FLOW BASIN
RETURN
WET WELL (SOUTH)
WET WELL (NORTH)
PLANT NO. 1 INFLUENT
FINE SCREEN
UV DISINFECTION
REAERATION 3 - OXY CHAMBERS
MASTER METER
TRAIN NO. 3
TRAIN NO. 2
TRAIN NO. 1
FLOW DISTRIBUTION BOX
DISTRIBUTION BOX
AERATION BASIN
AIR
FINAL CLARIFIER
SCUM BOX
RAS
WAS
FIL
SUB
ARKANSAS RIVER
PLANT 2 SOLIDS STREAM
SLUDGE SCREEN (3)
MIXED SLUDGE DISTRIBUTION BOX
DAF (3)
POL
THICKENER BOTTOM SLUDGE PUMP (3)
THICKENED FLOAT PUMP (6)
BLEND TANK
DIGESTER FEED PUMP (4)
DIGESTERS (4)
MIXING PUMP (20)
HEAT EXCHANGER
BOILER
SLUDGE HOLDING TANK (3)
BELT FILTER PRESS (4)
FILTRATE TANKS (2)
FILTRATE EQUALIZATION PUMP (20)
SLUDGE STORAGE FACILITY AND LAND APPLICATION
LEGEND
GRIT CLASSIFIER
DUMPSTER
PUMP
DUMPTRUCK
BAR SCREEN
WEIR PLATE
SLIDE GATE
DIRECTION OF FLOW
MIXER
BUTTERFLY VALVE W/ OPERATOR
CITY OF WICHITA, KANSAS
WASTEWATER TREATMENT PLANT NO. 1
WASTEWATER TREATMENT PLANT NO. 2
FLOW SCHEMATIC
WASTEWATER TREATMENT PLANT NO.2 NUTRIENT LOADING EVALUATION
Professional Engineering Consultants, P.A.
303 S. TOPEKA • WICHITA, KANSAS 67202
316-262-2691 • FAX 316-262-3003
Job No. 34-08198
Drawn by BB
Date DECEMBER 2008
PS

Kansas Permit No.: M-AR94-IO01

Federal Permit No.: KS0043036

KANSAS WATER POLLUTION CONTROL PERMIT AND AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

Pursuant to the Provisions of Kansas Statutes Annotated 65-164 and 65-165, the Federal Water Pollution Control Act as amended, (33 U.S.C. 1251 et seq; the "Act"),

Owner:	Wichita, City of
Owner's Address:	Water Utilities City Hall - Eighth Floor 455 North Main St. Wichita, KS 67202
Facility Name:	Wichita Wastewater Treatment Plants 1 and 2
Facility Location:	2305 East 57th Street South Wichita, KS 67216 Center Section, Section 27, Township 28S, Range 1E Sedgwick County, Kansas
Receiving Stream & Basin:	Arkansas River Lower Arkansas River Basin

is authorized to discharge from the wastewater treatment facility described herein, in accordance with effluent limitations and monitoring requirements as set forth herein.

This permit is effective ____________________, supersedes the previously issued water pollution control permit M-AR94-IO01, and expires ____________________.

FACILITY DESCRIPTION:

See next page.

____

Secretary, Kansas Department of Health and Environment

____

Date

Facility Description:

Plant No. 1

1. Raw Wastewater Pumping
2. Extraneous Flow Basin

Plant No. 2

1. Raw Wastewater Pumping
2. Primary Clarification
3. Settled Wastewater Pumping
4. Trickling Filters
5. Clarification
6. Screw Pump, Intermediate Pumping Station
7. Activated Sludge Aeration Basins

Plant No. 2 (continued)

8. Final Clarification
9. UV Disinfection Facility
10. Reaeration
11. Gravity Belt Sludge Thickener
12. Belt Filter Presses
13. Anaerobic Digestion
14. Sludge Processing
15. Design Flow = 54 MGD
16. Dissolved Air Flotation Sludge Thickener
17. Sludge Screening Facility
18. Sludge Storage Building
19. Biofilter Odor Control System
20. Septage Receiving Station

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

The permittee is authorized to discharge from outfall(s) with serial number(s) as specified in this permit. The effluent limitations shall become effective on the dates specified herein. Such discharges shall be controlled, limited, and monitored by the permittee as specified. There shall be no discharge of floating solids or visible foam in other than trace amounts.

Monitoring reports shall be submitted on or before the 28th day of the following month. In the event no discharge occurs, written notification is still required.

	EFFLUENT LIMITATIONS	MONITORING REQUIREMENTS	
Effective Date	Final Limitations Upon Issuance		
Outfall Number and Effluent Parameter(s)		Measurement Frequency	Sample Type
001AG - Influent to Treatment Plant No. 2			
Biochemical Oxygen Demand (5-Day) - mg/l	Monitor	3 times/week	24-Hour Composite
Total Suspended Solids - mg/l	Monitor	3 times/week	24-Hour Composite
001A1 Outfall - Effluent at the Oxy Charger			
Biochemical Oxygen Demand (5-Day)-mg/L(1)		3 times/week	24-hour Composite
November through March			
Weekly Average	45		
Monthly Average	30		
April, September, and October			
Weekly Average	40		
Monthly Average	25		
May, June, July, and August			
Weekly Average	30		
Monthly Average	20		
Total Suspended Solids-mg/L(1)		3 times/week	24-hour Composite
Weekly Average	45		
Monthly Average	30		
Ammonia (as N)		3 times/week	24-hour Composite
January			
Daily Maximum-mg/l	10.9		
Monthly Average-mg/l	7.9		
February			
Daily Maximum-mg/l	9.0		
Monthly Average-mg/l	6.8		
March			
Daily Maximum-mg/l	8.2		
Monthly Average-mg/l	3.9		

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

April			
Daily Maximum-mg/l	8.2		
Monthly Average-mg/l	3.5		
May			
Daily Maximum-mg/l	8.2		
Monthly Average-mg/l	2.7		
June			
Daily Maximum-mg/l	9.0		
Monthly Average-mg/l	2.3		
July			
Daily Maximum-mg/l	6.2		
Monthly Average-mg/l	1.5		
August			
Daily Maximum-mg/l	14.2		
Monthly Average-mg/l	2.8		
September			
Daily Maximum-mg/l	10.9		
Monthly Average-mg/l	3.4		
October			
Daily Maximum-mg/l	10.9		
Monthly Average-mg/l	4.8		
November			
Daily Maximum-mg/l	9.0		
Monthly Average-mg/l	6.8		
December			
Daily Maximum-mg/l	7.5		
Monthly Average-mg/l	5.9		
Fecal Coliform-Colonies/100ml [4]		3 times/week	Grab
April through October			
Monthly Geometric Average	200		
November through March			
Monthly Geometric Average	2000		
E. Coli - Colonies/100ml [4]		3 times/week	Grab
April through October			
Monthly Geometric Average	160		
November through March			
Monthly Geometric Average	2358		
pH - Standard Units	6.0-9.0	Daily	Grab
Dissolved Oxygen-mg/l			
Weekly Average (Minimum)	6.0	Daily	Grab
Temperature - °C	Monitor	Weekly	Grab

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

Total Phosphorus (as P)-mg/l (lbs/day)	Monitor (Calculate)	Monthly	Grab
Nitrate (NO_3)as N-mg/l	Monitor	Monthly	Grab
Nitrite (NO_2)as N-mg/l	Monitor	Monthly	Grab
Total Kjeldahl Nitrogen (as N)-mg/l	Monitor	Monthly	Grab
Total Nitrogen (as N)-mg/l (lbs/day) (TKN + NO_3 + NO_2)	Calculate (Calculate)	Monthly	Calculate
Chlorides-mg/l	Monitor	Monthly	Grab
Copper - (Total Recoverable)-µg/l[5]	Monitor	Monthly	Grab
Whole Effluent Toxicity - See Supplemental Conditions G.1.			
Priority Pollutant Scan - See Supplemental Conditions G.2.			
Flow - MGD	Monitor	Daily	Meter

002A1 - Extraneous Flow Basin [(2)] at the basin discharge structure

Biochemical Oxygen Demand (5-Day)-mg/l	Monitor	Daily per Occurrence	24-Hour[(3)] Composite
Total Suspended Solids-mg/l	Monitor	Daily per Occurrence	24-Hour[(3)] Composite
Fecal Coliform - (Colonies/100 ml)[4]	Monitor	Daily Per Occurrence	Grab
E. coli - (Colonies/100 ml)[4]	Monitor	Daily Per Occurrence	Grab
pH - Standard Units	Monitor	Daily Per Occurrence	Grab
Flow - MGD	Monitor	Daily Per Occurrence	Meter

005A1 - Arkansas River at 47th Street

Fecal Coliform - (Colonies/100 ml)[4]	Monitor		Grab
April - October		Weekly	
November - March		Monthly	
E. coli - (Colonies/100 ml)[4]	Monitor		Grab
April - October		Weekly	
November - March		Monthly	
Total Hardness (as CaCO3)- mg/l	Monitor	Monthly	Grab
Dissolved Oxygen-mg/l	Monitor	Monthly	Grab
Temperature - •€	Monitor	Monthly	Grab
pH - Standard Units	Monitor	Monthly	Grab
Chlorides-mg/l	Monitor	Monthly	Grab

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Ammonia (as N) - mg/l	Monitor	Monthly	Grab
Nitrate (NO_3)as N-mg/l	Monitor	Monthly	Grab
Total Kjeldahl Nitrogen (as N)-mg/l	Monitor	Monthly	Grab
Total Phosphorus (as P)-mg/l	Monitor	Monthly	Grab

FOOTNOTES:

(1) Minimum of 85% removal required for BOD_5 and TSS. If inhibited BOD_5 test is used, limits are 5 mg/l less than shown.

(2) Plant 2 shall be discharging, through the 001 outfall, at or above 54 MGD prior to allowing any discharge of effluent through the 002 outfall. Alternately, the permittee may discharge effluent through the 002 outfall when approved by KDHE under item 9, Immediate Reporting Required, in the Standard Conditions as attached to this permit.

(3) In the event discharge from the extraneous flow basin ends prior to completion of the 24 hour composite period, the basin discharge samples shall be composited and analysis completed. Either flow weighted or time weighted composite samples are permitted.

(4) On July 1, 2008, permittee shall switch from the fecal coliform test to the E. coli test.

(5) Minimum detection limit for total recoverable copper shall be 10 µg/l.

B. STANDARD CONDITIONS

In addition to the specified conditions stated herein, the permittee shall comply with the attached Standard Conditions dated August 1, 1996.

C. SLUDGE REQUIREMENTS

Sludge disposal shall be in accordance with the 40 CFR Part 503 Sludge Regulations.

D. SCHEDULE OF COMPLIANCE

1. Within two years of the effective date of this permit, the permittee will conduct a study to assess the cost and feasibility for this facility to meet a proposed Total Nitrogen (as N) goal of 8.0 mg/l and Total Phosphorus (as P) goal of 1.5 mg/l as annual average concentrations in the effluent. The study will include operational and capital costs for 1) operational changes, if feasible, 2) physical and chemical treatment additions, and 3) biological treatment additions to meet the stated goals.

2. Within two months of completing the study, the permittee shall provide the study results to KDHE.

E. PRETREATMENT

The permittee shall implement and administer the pretreatment program in accordance with the General Pretreatment Regulations 40 CFR Part 403, as approved by the Kansas Department of Health and Environment and the Environmental Protection Agency.

F. BIOMONITORING AND PRIORITY POLLUTANTS

1. Whole Effluent Toxicity:

a. Chronic Whole Effluent Toxicity (WET) testing on a 24-hr composite sample of the effluent shall be conducted quarterly. The 25% Inhibition Concentration, IC25, shall be equal to or greater than 66% effluent. Test results less than 66% are violations of this permit. The test procedures shall use the seven day static renewal test method in accordance with the EPA document, Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, fourth edition, October 2002 using test organisms *Pimephales promelas* (fathead minnow) and *Ceriodaphnia dubia* (water flea) within a dilution series containing 0%, 25%, 50%, 66%, 80%, and 100% effluent. KDHE reserves the right to increase or decrease testing frequency based upon compliance history and toxicity testing results.

b. If the WET test results indicate the IC25 is equal to or greater than 66% effluent, the effluent has passed the toxicity test and a copy of the test report shall be due with the next scheduled Discharge Monitoring Report.

c. If the WET test results indicate the IC25 is less than 66% effluent, the effluent has failed the toxicity test and the permittee shall immediately notify KDHE by telephone at(785) 296-5517 and submit to KDHE a copy of the test report within five days of receipt of the information. KDHE reserves the right to require the permittee to take such actions as are reasonable to identify and remedy any identified or predicted toxic conditions in the receiving stream outside of the mixing zone which is caused by the permittee's effluent.

d. Permittee shall also test a portion of one of same effluent samples used for the WET test for the following parameters (required minimum reportable detection levels are in parenthesis):

Antimony (10 µg/L)*	Nickel (10 µg/L)*
Arsenic (10 µg/L)*	Selenium (5 µg/L)*
Beryllium (5 µg/L)*	Silver (2 µg/L)*
Cadmium (2 µg/L)*	Thallium (10 µg/L)*
Chromium (10 µg/L)*	Zinc (20 µg/L)*
Copper (10 µg/L)*	Total Hardness as CaCO3 mg/l
Lead (5 µg/L)*	
Mercury (0.2 µg/L-Cold Vapor Method)	

* Parameter shall be tested and reported as "total recoverable" metals.

e. The permittee shall coordinate sampling for this test with other requirements of this permit. The permittee shall use a laboratory approved by KDHE for Whole Effluent Toxicity testing.

2. Permittee shall conduct a Priority Pollutant Scan on the effluent for the parameters listed in Table I, Priority Pollutant Scan, on the following pages. The Priority Pollutant Scan shall be conducted between January 1 and June 30, 2012 and the shall be reported with the next Discharge Monitoring Report following receipt of the results but not later than August 28, 2012.

Sample type shall be 24-hour composite except for Volatiles which shall be a grab sample. See Supplemental Condition F.1.d. for minimum detection limits for certain metals in the Priority Pollutant Scan.

Table I
Priority Pollutant Scan

Metals
- Total Recoverable Arsenic (ug/l)
- Total Recoverable Beryllium (ug/l)
- Total Recoverable Cadmium (ug/l)
- Total Recoverable Chromium (ug/l)
- Total Recoverable Copper (ug/l)
- Total Recoverable Lead (ug/l)
- Total Mercury (ug/l)
- Total Recoverable Molybdenum (ug/l)
- Total Recoverable Potassium (ug/l)
- Total Recoverable Nickel (ug/l)
- Total Recoverable Selenium (ug/l)
- Total Recoverable Silver (ug/l)
- Total Recoverable Thallium (ug/l)
- Total Recoverable Zinc (ug/l)

Pesticides
- Aldrin (mg/l)
- Alpha-BHC (mg/l)
- Beta-BHC (mg/l)
- Gamma-BHC (mg/l)
- Delta-BHC (mg/l)
- Chlordane (mg/l)
- 4,4-DDT (mg/l)
- 4,4-DDD (mg/l)
- 4,4-DDE (mg/l)
- Dieldrin (mg/l)
- Alpha-endosulfan (mg/l)
- Beta-endosulfan (mg/l)
- Endosulfan sulfate (mg/l)
- Endrin (mg/l)
- Endrin aldehyde (mg/l)
- Heptachlor (mg/l)
- Heptachlor epoxide (mg/l)
- Toxaphene (mg/l)
- Malathion (mg/l)
- Diazinon (mg/l)

Polychlorinated Biphenyls (mg/l)
- PCB-1242
- PCB-1254
- PCB-1221
- PCB-1232
- PCB-1248
- PCB-1260
- PCB-1016

Priority Pollutant Scan (continued)

Base/Neutral
- Acenaphthene (mg/l)
- Acenaphtylene (mg/l)
- Anthracene (mg/l)
- Benzidine (mg/l)
- Benzo(a) anthracene (mg/l)
- Benzo(a)pyrene (mg/l)
- 3,4-benzofluoranthene (mg/l)
- Benzo (ghi) perylene (mg/l)
- Benzo (b) fluoranthene (mg/l)
- Bis(2-chloroethoxy)methane (mg/l)
- Bis(2-chloroethyl)ether (mg/l)
- Bis(2-ethylhexyl)phthalate (mg/l)
- Bis(2-chloroisopropyl) ether (mg/l)
- 1,2-diphenylhydrazine (mg/l)
- Fluoranthene (mg/l)
- Fluorene (mg/l)
- Nitrobenzene (mg/l)
- N-nitrosodimethylamine (mg/l)
- N-nitrosodi-n-propylamine (mg/l)
- N-nitrosodiphenylamine (mg/l)
- Phenanthrene (mg/l)
- Pyrene (mg/l)
- 1,2,4-trichlorobenzene (mg/l)
- 4-bromophenyl phenyl ether (mg/l)
- Butyl benzyl phthalate (mg/l)
- 2-chloronaphthalene (mg/l)
- 4-chlorophenyl phenyl ether (mg/l)
- Chrysene (mg/l)
- Dibenzo(a,h) anthracene (mg/l)
- 1,2-dichlorobenzene (mg/l)
- 1,3-dichlorobenzene (mg/l)
- 1,4-dichlorobenzene (mg/l)
- 3,3-dichlorobenzidine (mg/l)
- Dimethyl phthalate (mg/l)
- Diethyl phthalate (mg/l)
- Di-n-butyl phthalate (mg/l)
- 2,4-dinitrotoluene (mg/l)
- 2,6-dinitrotoluene (mg/l)
- Di-n-octyl phthalate (mg/l)
- Hexachlorobenzene (mg/l)
- Hexachlorobutadiene (mg/l)
- Hexachlorocyclopentadiene (mg/l)
- Hexachloroethane (mg/l)
- Indeno (1,2,3-cd) pyrene (mg/l)
- Naphthalene (mg/l)
- Isophorone (mg/l)

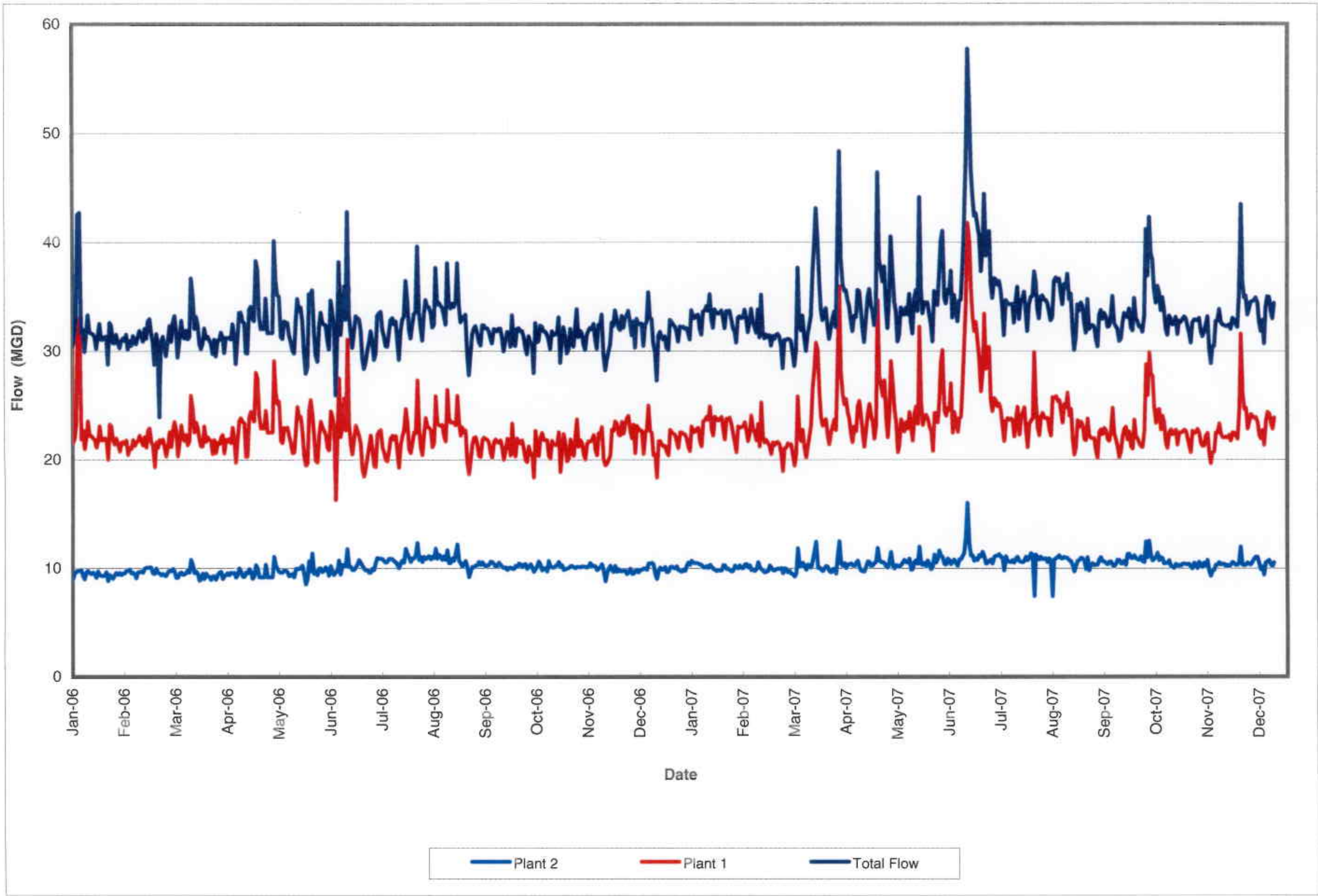
Priority Pollutant Scan (continued)

Acid Compounds
- 2-chlorophenol (mg/l)
- 2,4-dichlorophenol (mg/l)
- 2,4-dimethylphenol (mg/l)
- 2,4-dinitrophenol (mg/l)
- 2-nitrophenol (mg/l)
- 4-nitrophenol (mg/l)
- Parachlorometa cresol (mg/l)
- Pentachlorophenol (mg/l)
- Phenol (mg/l)
- 4,6-dinitro-o-cresol (mg/l)
- 2,4,6-trichlorophenol (mg/l)

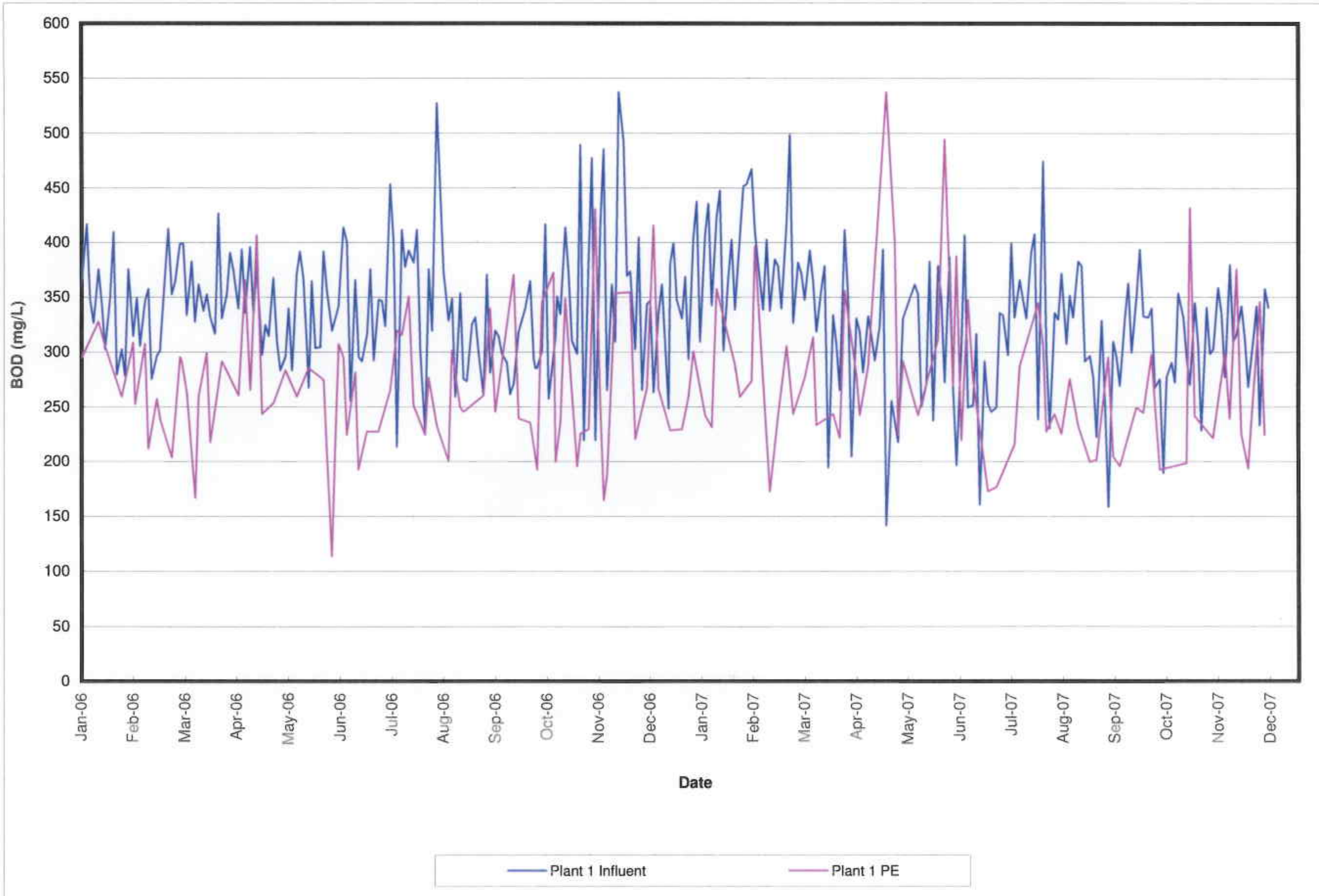
Volatiles
- Acrolein (mg/l)
- Acrylonitrile (mg/l)
- Benzene (mg/l)
- Bromoform (mg/l)
- Carbon Tetrachloride (mg/l)
- Chlorobenzene (mg/l)
- Chlorodibromomethane (mg/l)
- Chloroethane (mg/l)
- 2-chloroethylvinyl ether (mg/l)
- Chloroform (mg/l) (mg/l)
- Dichlorobromomethane (mg/l)
- 1,1-dichloroethane (mg/l)
- 1,2-dichloroethane (mg/l)
- 1,1-dichloroethylene (mg/l)
- 1,2-dichloropropane (mg/l)
- 1,3-dichloropropylene (mg/l)
- Ethylbenzene (mg/l)
- Methyl bromide (mg/l)
- Methyl chloride (mg/l)
- Methylene chloride (mg/l)
- 1,1,2,2-tetrachloroethane (mg/l)
- Tetrachloroethylene (mg/l)
- Toluene (mg/l)
- 1,2 trans-dichloroethylene (mg/l)
- 1,1,1-trichloroethane (mg/l)
- 1,1,2-trichloroethane (mg/l)
- Trichloroethylene (mg/l)
- Vinyl chloride (mg/l)

Miscellaneous
- Total Cyanide (mg/l)*
- Total Phenols (mg/l)

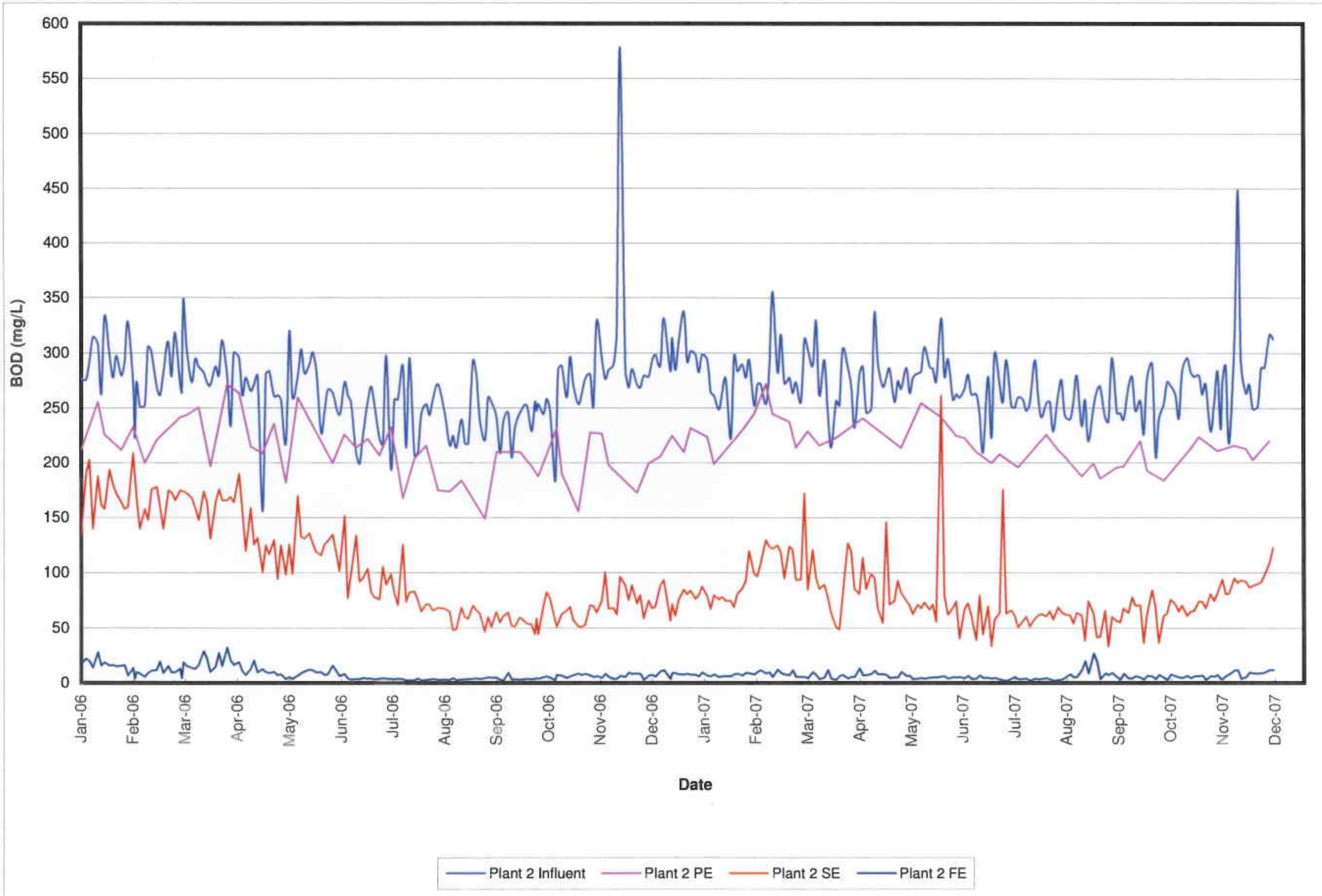
* The total cyanide analysis must include preliminary treatment of the sample to avoid NO_2^- interference. Addition of sulfamic acid to the sample before distillation can prevent such interference. See Standard Methods for the Examination of Water and Wastewater, 18th Edition, 4500-CN^- B. Preliminary Treatment of Samples.

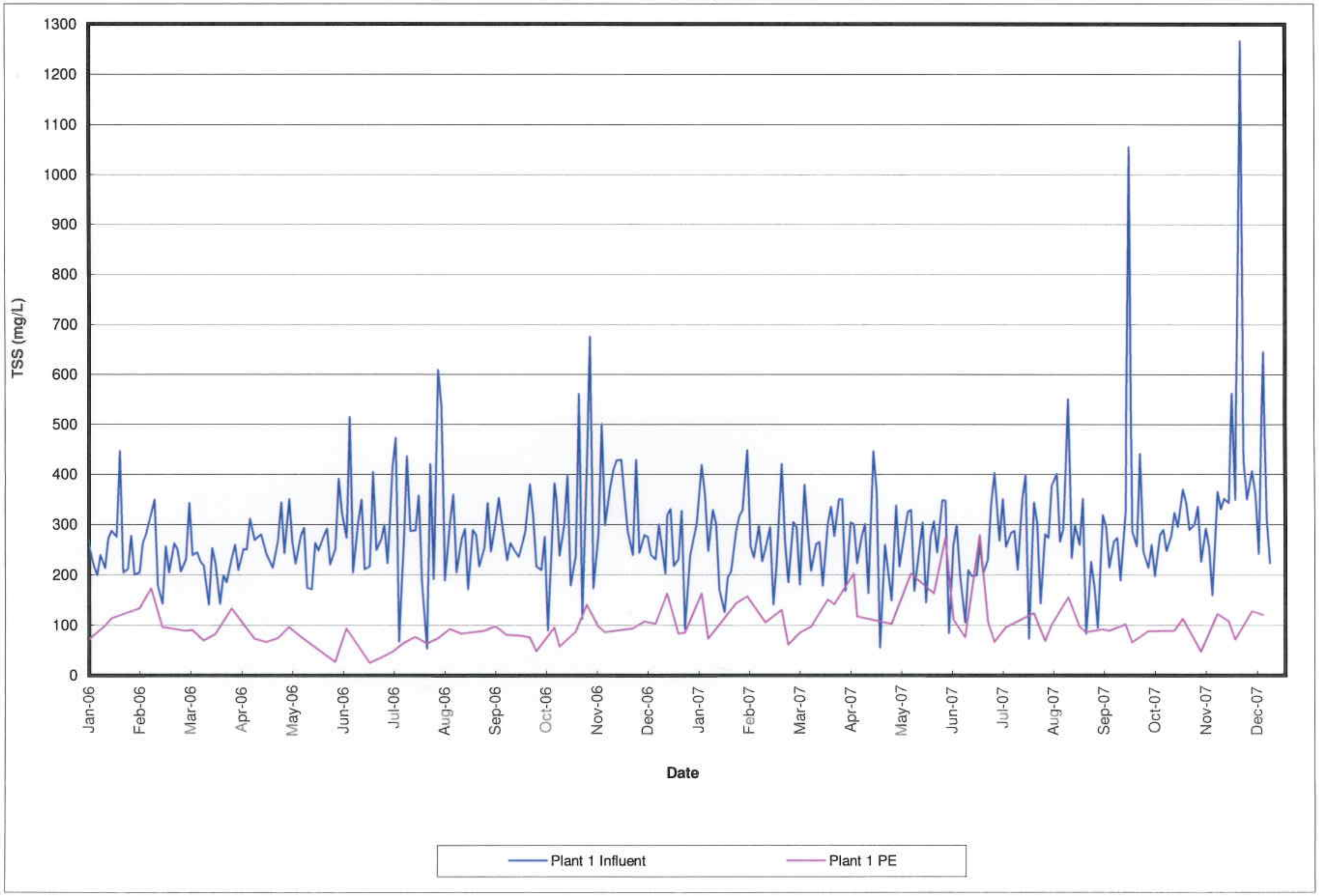


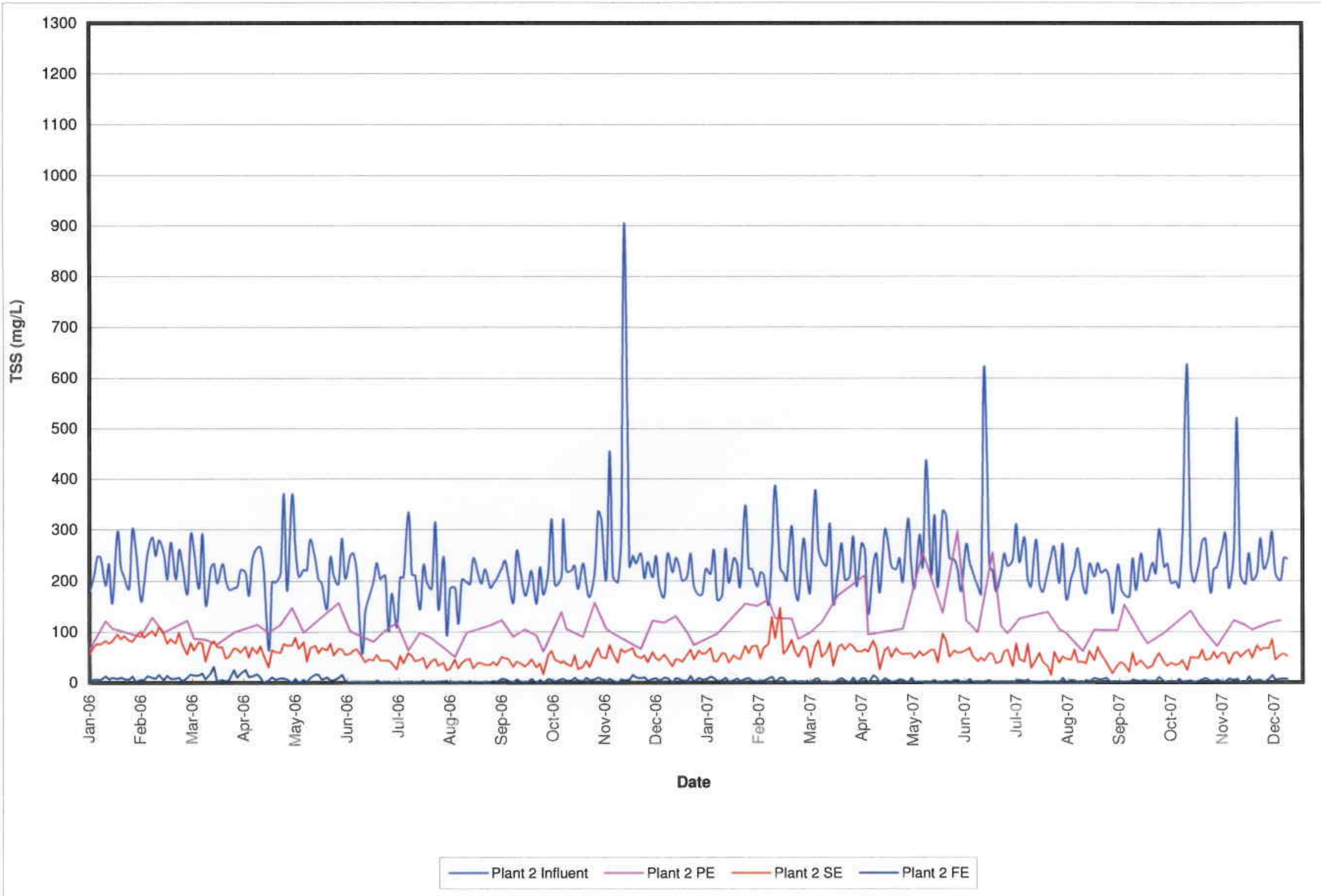
60
50
40
30
20
10
0
Flow (MGD)
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Date
Plant 2
Plant 1
Total Flow

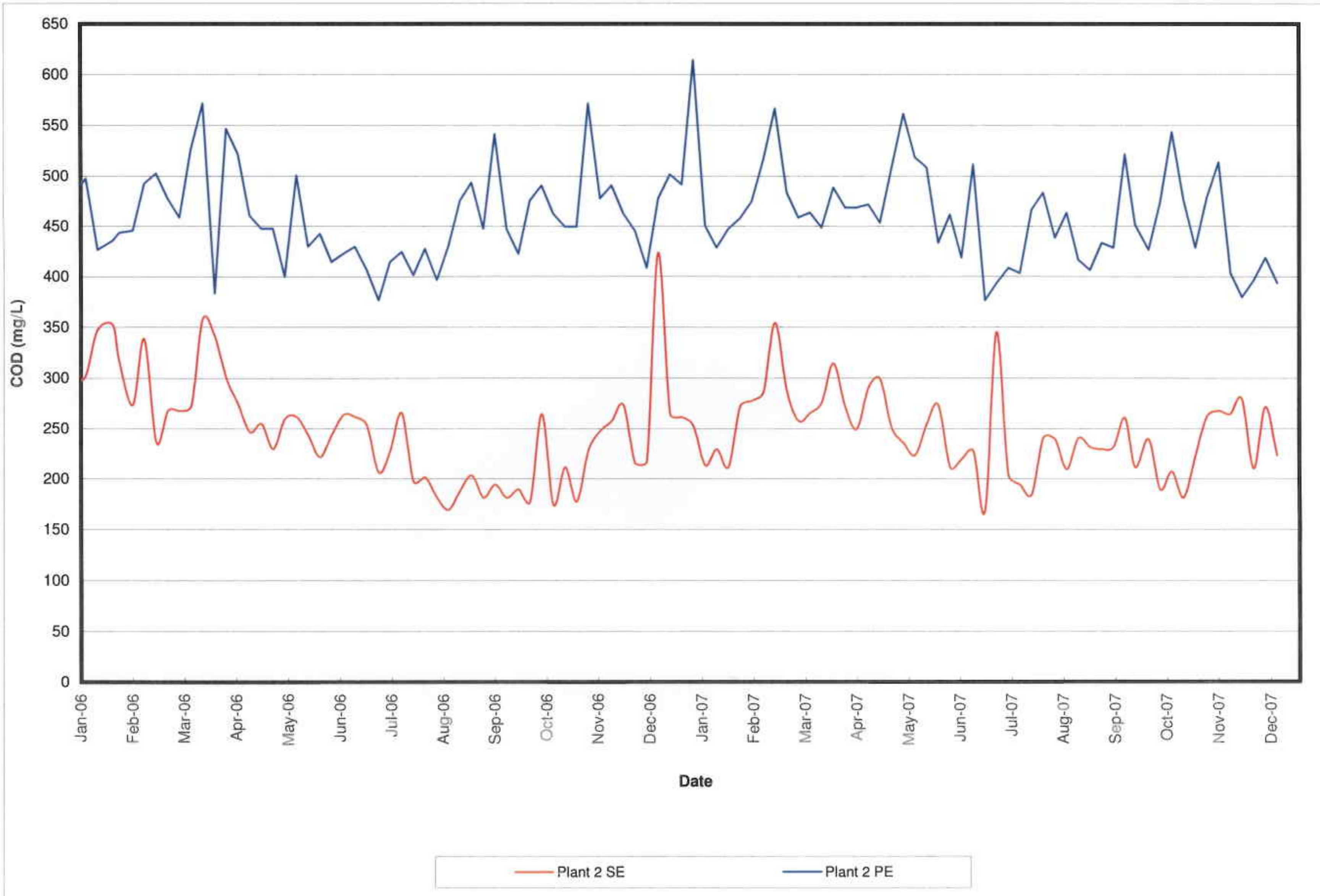


BOD (mg/L)
600
550
500
450
400
350
300
250
200
150
100
50
0
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Date
Plant 1 Influent
Plant 1 PE

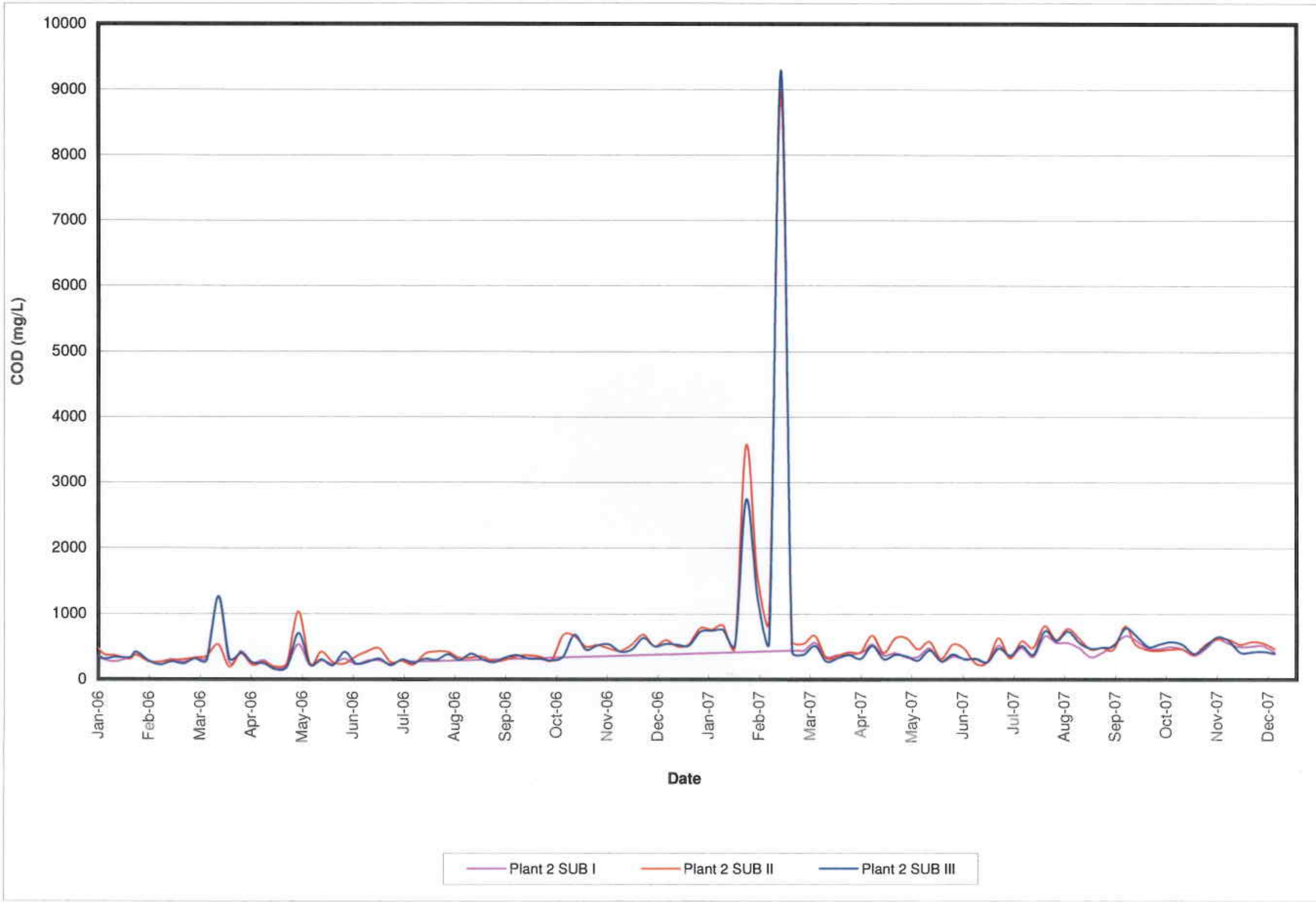

BOD (mg/L)
600
550
500
450
400
350
300
250
200
150
100
50
0
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Date
Plant 2 Influent
Plant 2 PE
Plant 2 SE
Plant 2 FE

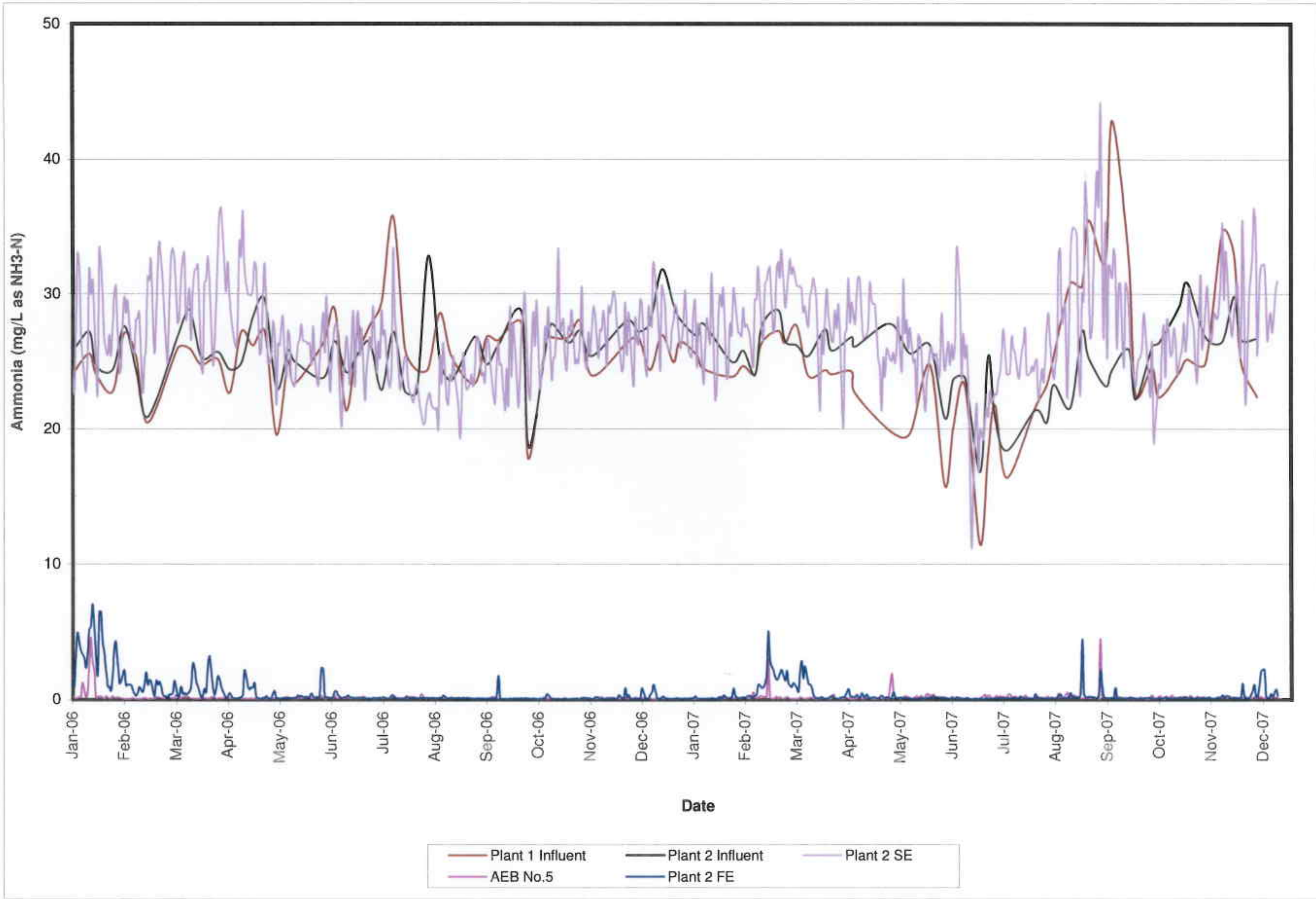

TSS (mg/L)
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Date
Plant 1 Influent
Plant 1 PE


TSS (mg/L)
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Date
Plant 2 Influent
Plant 2 PE
Plant 2 SE
Plant 2 FE

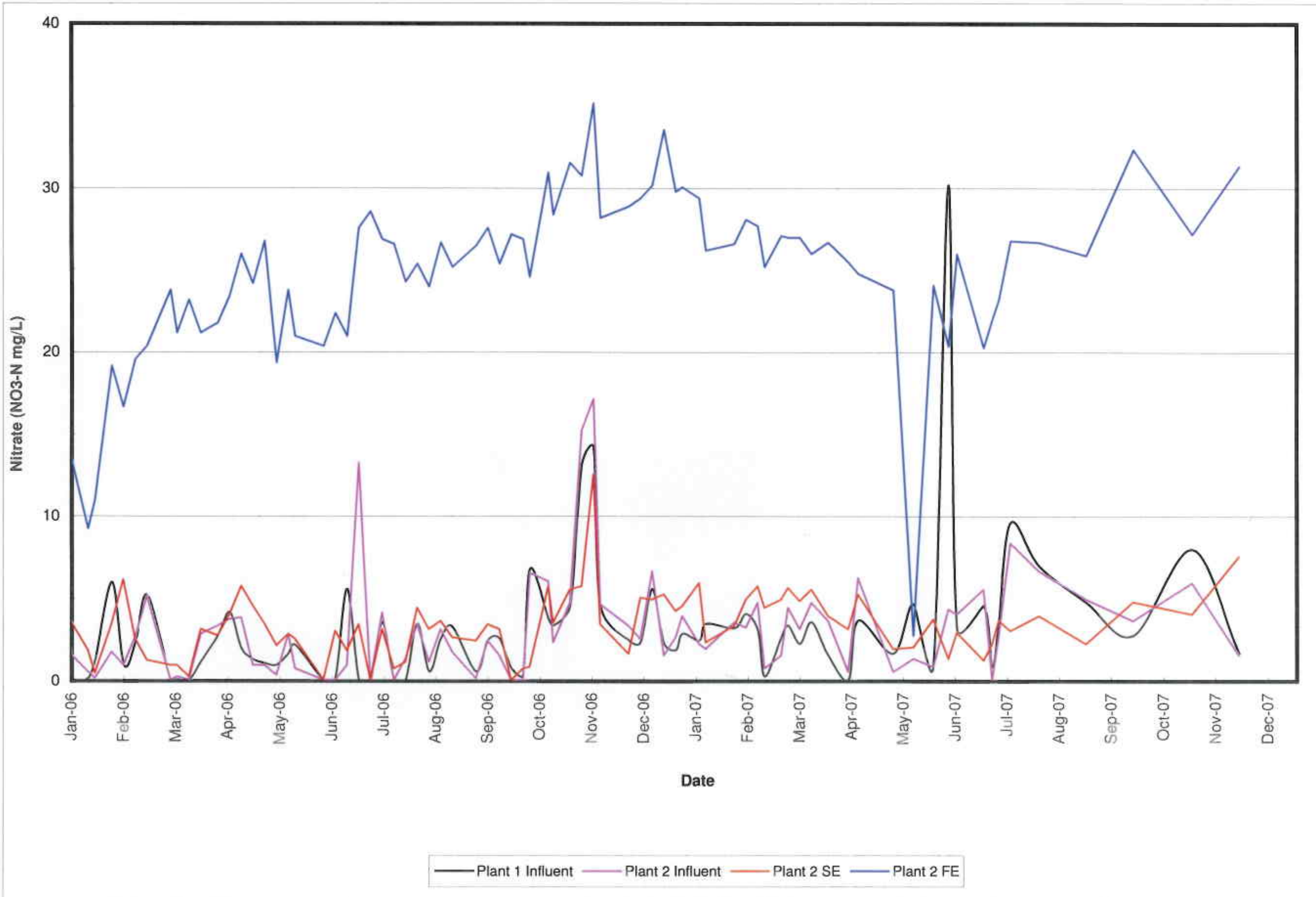


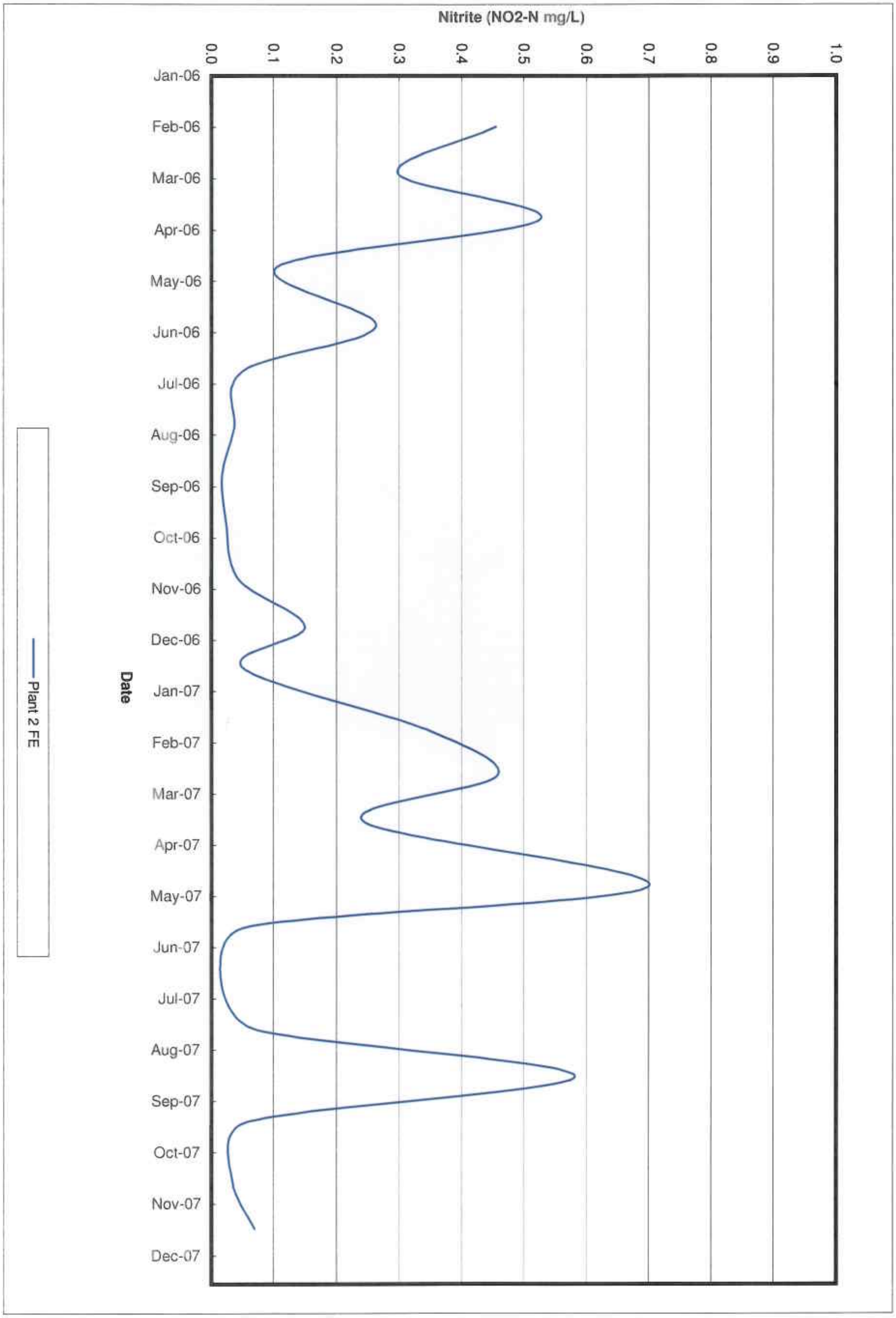
COD (mg/L)
650
600
550
500
450
400
350
300
250
200
150
100
50
0
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Date
Plant 2 SE
Plant 2 PE


COD (mg/L)
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Date
Plant 2 SUB I
Plant 2 SUB II
Plant 2 SUB III



Ammonia (mg/L as NH3-N)
50
40
30
20
10
0
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Date
Plant 1 Influent
Plant 2 Influent
Plant 2 SE
AEB No.5
Plant 2 FE


Nitrate (NO3-N mg/L)
40
30
20
10
0
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Date
Plant 1 Influent
Plant 2 Influent
Plant 2 SE
Plant 2 FE



Nitrite (NO2-N mg/L)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
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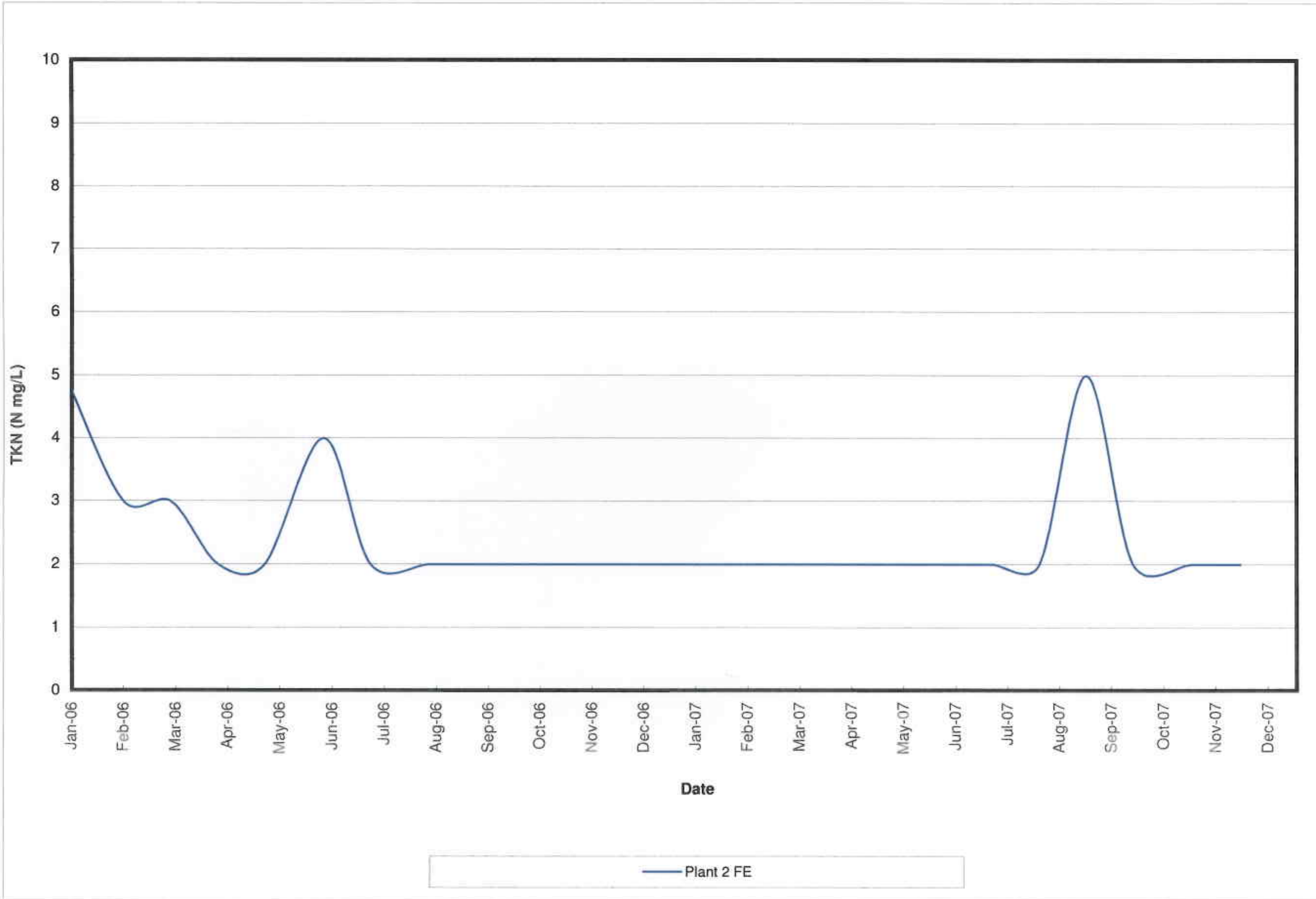
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Date
Plant 2 FE


TKN (N mg/L)
0
1
2
3
4
5
6
7
8
9
10
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
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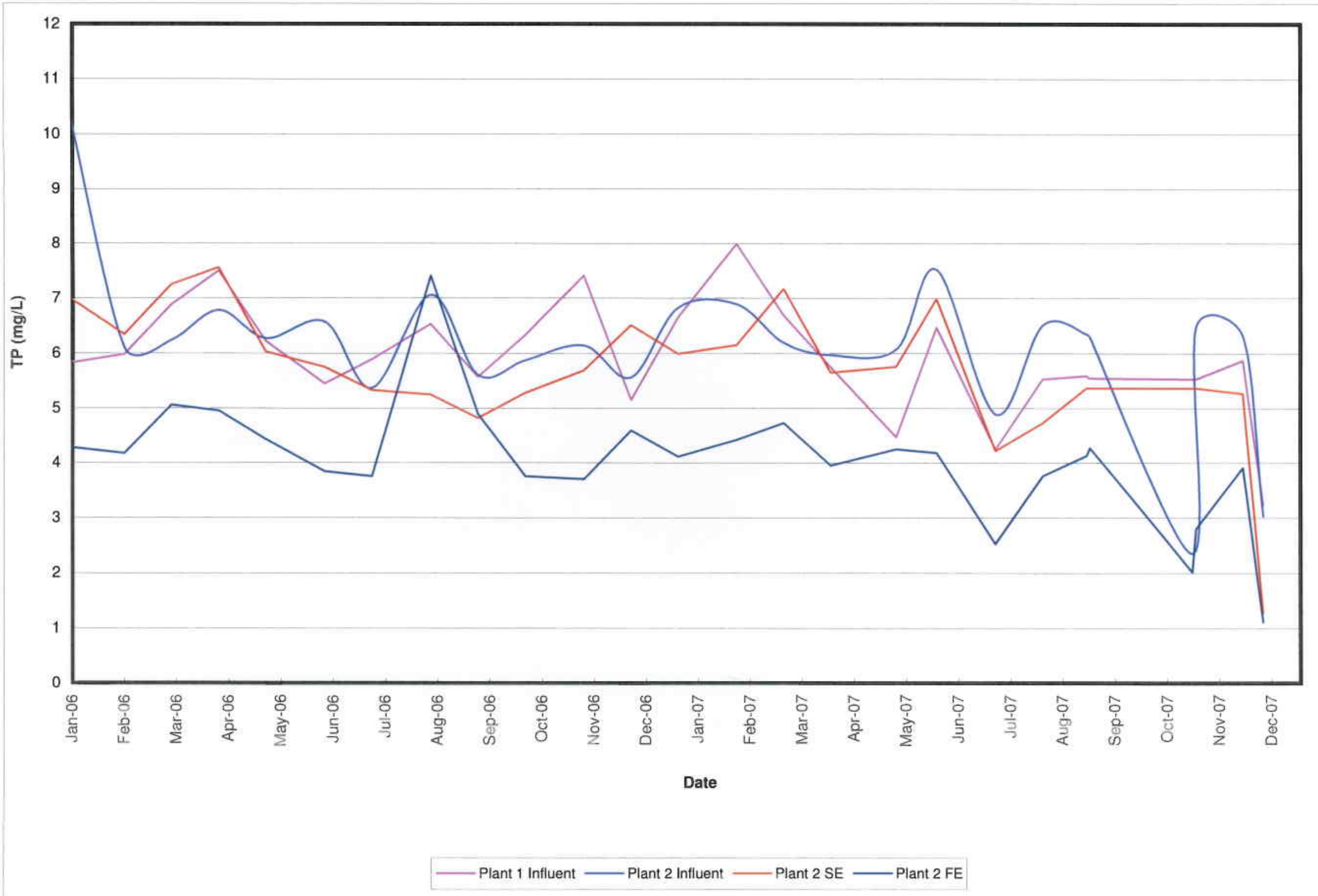
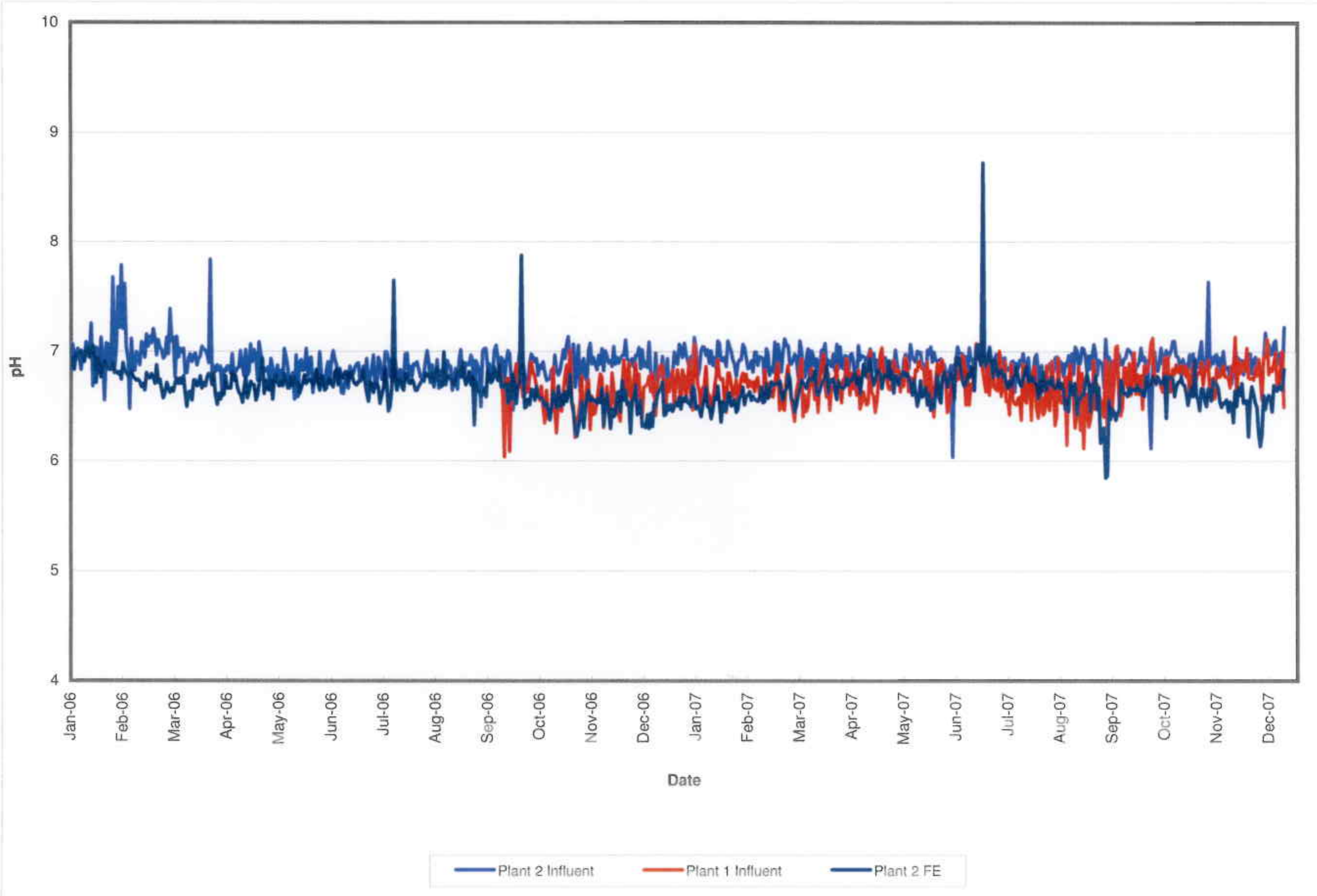
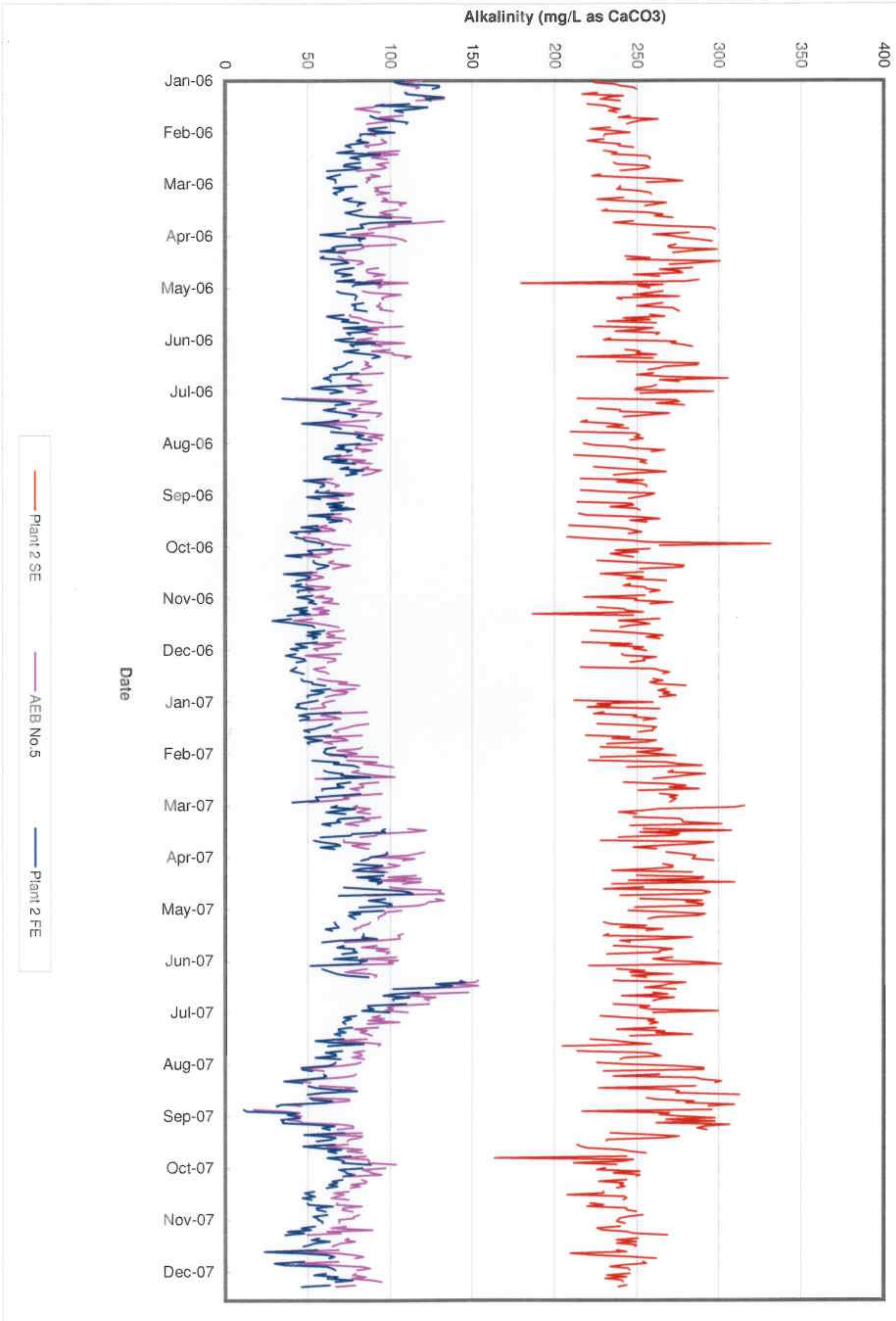
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Date
Plant 2 FE

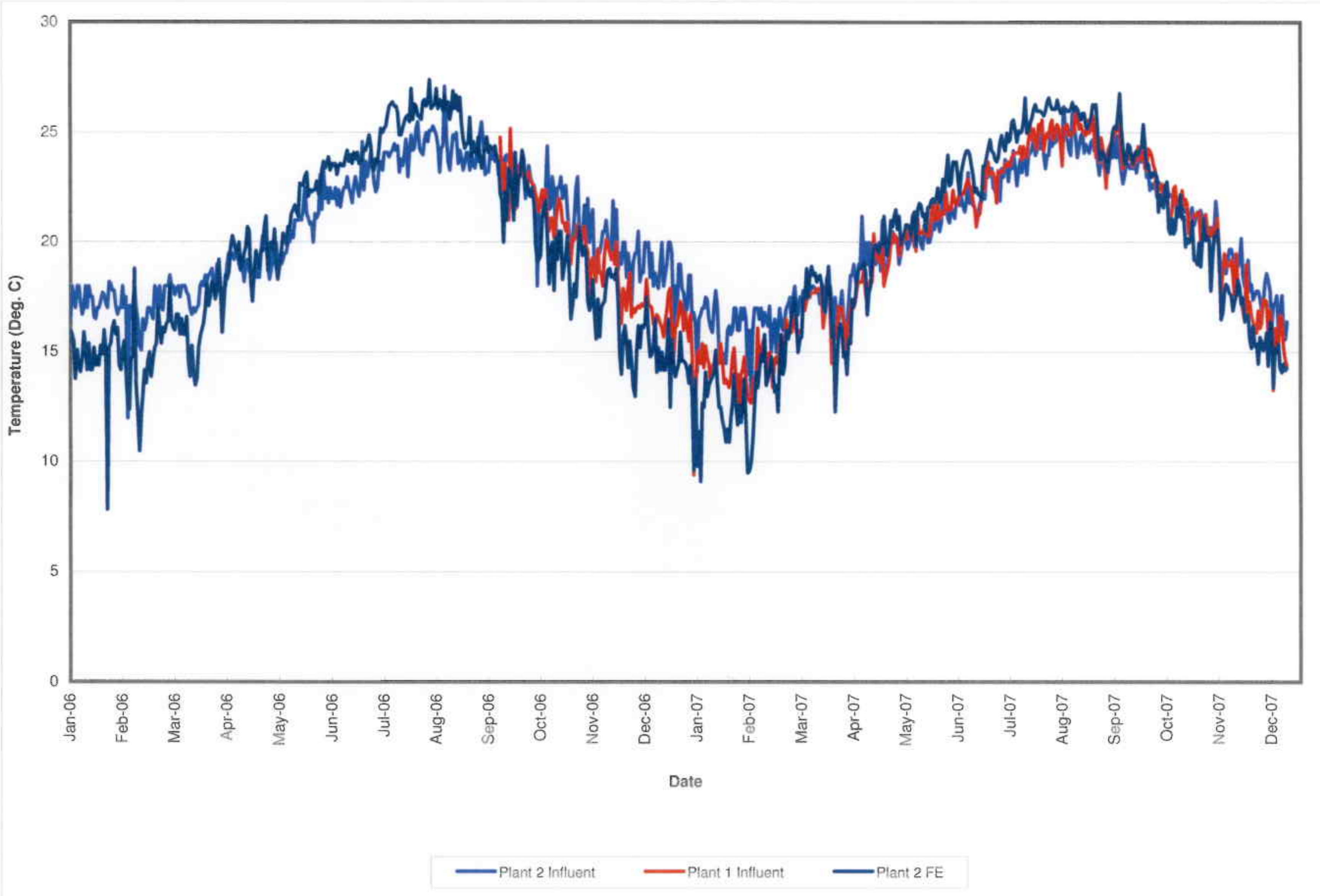

TP (mg/L)
0
1
2
3
4
5
6
7
8
9
10
11
12
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Date
Plant 1 Influent
Plant 2 Influent
Plant 2 SE
Plant 2 FE



pH
10
9
8
7
6
5
4
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Date
Plant 2 Influent
Plant 1 Influent
Plant 2 FE



Alkalinity (mg/L as CaCO3)
0
50
100
150
200
250
300
350
400
Date
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Plant 2 SE
AEB No.5
Plant 2 FE


Temperature (Deg. C)
30
25
20
15
10
5
0
Jan-06
Feb-06
Mar-06
Apr-06
May-06
Jun-06
Jul-06
Aug-06
Sep-06
Oct-06
Nov-06
Dec-06
Jan-07
Feb-07
Mar-07
Apr-07
May-07
Jun-07
Jul-07
Aug-07
Sep-07
Oct-07
Nov-07
Dec-07
Date
Plant 2 Influent
Plant 1 Influent
Plant 2 FE

Project Name : **Wichita Wastewater Treatment Plant No.2 Nutrient Loading Evaluation**
PEC Project No.: 34-08198-0042

Reference: IPP data (provided by Rebecca Gagnon, 6/17/08)

CITY OF WICHITA - WATER UTILITIES

INDUSTRIAL PERMIT CATEGORIES

CATEGORY I > 500,000 GPD FLOWRATE

INDUSTRY	AVERAGE FLOW GAL/DAY
BOEING COMPANY	3,100,000
RAYTHEON	600,000
CESSNA MID-CONTINENT	1,800,000
Total Flow	5,500,000
% of Total Flow	60.25%

CATEGORY II 200,000-499,999 GPD Flowrate

INDUSTRY	AVERAGE FLOW GAL/DAY
McCONNELL AFB	400,000
FARMLAND FOODS	300,000
CARGILL I & II	300,000
Total Flow	1,000,000
% of Total Flow	10.96%

CATEGORY II - 200K - 100K

INDUSTRY	AVERAGE FLOW GAL/DAY
PEPSI COLA BOTTLING	178,000
WICHITA COCA-COLA	163,000
LEARJET	163,000
WESLEY MEDICAL CENTER	158,000
COLEMAN COMPANY - NE PLANT	141,000
HILAND DAIRY	135,000
DOLD FOODS	130,000
SONACA NMFA	120,000
NATIONAL BY-PRODUCTS	112,000
ST. FRANCIS MED CENTER	102,485
AIR CAPITAL PLATING	102,000
Total Flow	1,504,485
% of Total Flow	16.48%

CATEGORY III 99K - 60K

INDUSTRY	AVERAGE FLOW GAL/DAY
CINTAS	93,000
KANSAS PLATING	82,000
WESTERN UNIFORM & TOWEL	80,000
YORK UPG	72,200
METAL FINISHING	70,000
ARAMARK	67,000
CESSNA PAWNEE	58,000
Total Flow	522,200
% of Total Flow	5.72%

CATEGORY IV <60K - 30K

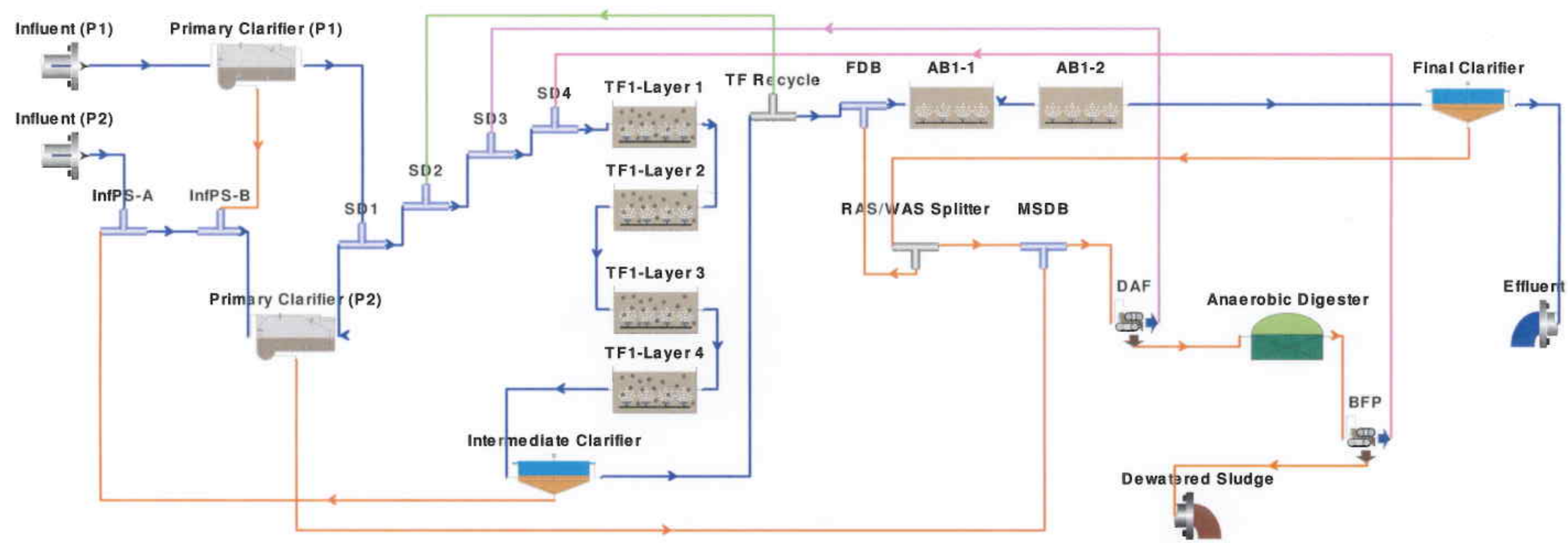
INDUSTRY	AVERAGE FLOW GAL/DAY
CESSNA PAWNEE	58,000
ST. JOSEPH MED CENTER	55,000
APEX ENGINEERING	49,000
HARPER TRUCKS	45,718
AMERIPRIDE	41,000
INFINTECH	33,000
CHEMICAL WASTE MNGT	30,000
LOVE BOX, INC	30,000
Total Flow	341,718
% of Total Flow	3.74%

CATEGORY V <30K

INDUSTRY	AVERAGE FLOW GAL/DAY
AIR PRODUCTS	26,000
FIBERGLASS SYSTEMS LLC	23,000
CASE NEW HOLLAND	21,000
WASTECONNECTIONS TRANSFER STATION	20,000
PARAGON	18,000
SHARPLINE	18,000
COASTAL REFINING CO	15,000
CHANCE INDUSTRIES	13,600
POWDERTECH	13,000
DAWSON BROS.	12,500
VIA CHRISTI LAUNDRY	11,600
GLOBE ENGINEERING	11,000
TREATCO	8,000
HARLOWE AIRCRAFT	7,500
ADVANCE PRODUCTS	7,190
CENTER INDUSTRIES	5,000
WICHITA TRUCK WASH	4,800
REDDI-ROOT'R	4,000
BOB EISEL	3,600
TRAMCO	3,300
BROOKS LANDFILL	3,000
WICHITA GAS PRODUCERS	3,000
UNIVERSAL LUBRICANTS	2,100
THERMAL TRADE	2,000
WICHITA BRASS	2,000
HUMPHREY PRODUCTS	290
CONOCO PIPELINE	200
RIVER CITY PLATING	110
ASTEC NAIR	1,000
Total Flow	259,790
% of Total Flow	2.85%

Total Industrial Flow	9,128,193

Wichita WWTP No.2



Project Name : **Wichita Wastewater Treatment Plant No.2 Nutrient Loading Evaluation**
PEC Project No.: 34-08198-0042

BioWin Modeling Summary

Plant No.1

Influent	unit	Actual Data	Modeling Data
Flow	MGD	22.95	22.95
Alk.	mg/L		200
pH		6.71	6.71
Temp.	Deg. C	19.8	20
BOD	mg/L	335	334
TSS	mg/L	285	287
NH3-N	mg/L	25.3	25.3
NO3-N	mg/L	3.24	3.24
NO2-N	mg/L		0
TKN	mg/L		33.7
TN	mg/L		36.94
TP	mg/L	5.94	5.94
D.O.	mg/L		0
COD	mg/L		680

Plant No.2

Influent	unit	Actual Data	Modeling Data
Flow	MGD	10.18	10.18
Alk.	mg/L		200
pH		6.91	6.91
Temp.	Deg. C	20.4	20
BOD	mg/L	272	273
TSS	mg/L	231	232
NH3-N	mg/L	25.7	25.7
NO3-N	mg/L	3.18	3.18
NO2-N	mg/L		0
TKN	mg/L		34.3
TN	mg/L		37.5
TP	mg/L	6.16	6.16
D.O.	mg/L		0
COD	mg/L		555

Final Effluent	unit	Actual Data	Modeling Data
Flow	MGD	33.12	33.1
Alk.	mg/L	67.5	53.5
pH		6.68	6.33
Temp.	Deg. C	19.7	20
BOD	mg/L	6.72	3.7
TSS	mg/L	6.6	6.8
NH3-N	mg/L	0.49	0.35
NO3-N	mg/L	24.7	19.7
NO2-N	mg/L	0.2	0.26
TKN	mg/L	2.42	2.62
TN	mg/L	27.3	22.6
TP	mg/L	4.05	3.77
D.O.	mg/L		
COD	mg/L		41.9

Wichita Wastewater Treatment Plant No.2

PEC Project No. 34-08198-0042

BioWin user and configuration data

Project details

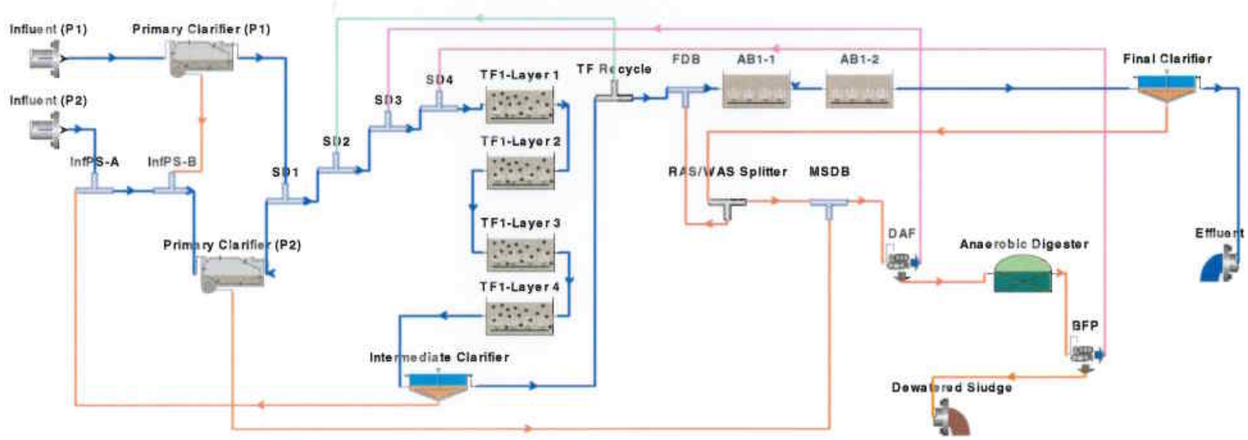
Project name: Wichita WWTP No.2 **Project ref.: BW3**

Plant name: Wichita WWTP No.2

Steady state solution

Temperature: 20.0 °C

Flowsheet



Configuration information for all Anaerobic Digester units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	Head space volume
Anaerobic Digester	7.2852	31416.0000	31.0	0.4

Operating data Average (flow/time weighted as required)

Element name	Pressure [psi]	pH
Anaerobic Digester	1.0	-

Element name	Average Temperature
Anaerobic Digester	35.0

Configuration information for all Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
AB1-1	4.0860	36414.5850	15.0	8251
AB1-2	9.3540	83363.1990	15.0	18890

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint [mg/L]
AB1-1	0.8
AB1-2	0.8

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
AB1-1	2.5656	0.0432	0.8200	0.0410	10.0000

AB1-2	2.5656	0.0432	0.8200	0.0410	10.0000

Element name	Alpha (surf) OR Alpha F (diff) [-]	Beta [-]	Surface pressure [kPa]	Fractional effective saturation depth (Fed) [-]
AB1-1	0.6000	0.9500	101.3250	0.3250
AB1-2	0.6000	0.9500	101.3250	0.3250

Element name	Supply gas CO2 content [vol. %]	Supply gas O2 [vol. %]	Off-gas CO2 [vol. %]	Off-gas O2 [vol. %]	Off-gas H2 [vol. %]	Off-gas NH3 [vol. %]	Off-gas CH4 [vol. %]	Surface turbulence factor [-]
AB1-1	0.0350	20.9500	2.0000	18.8000	0	0	0	2.0000
AB1-2	0.0350	20.9500	2.0000	18.8000	0	0	0	2.0000

Configuration information for all Effluent units

Configuration information for all Ideal clarifier units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Intermediate Clarifier	8.8885	66012.0000	18.0
Final Clarifier	12.6339	120636.0000	14.0

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Intermediate Clarifier	Fraction	0.02
Final Clarifier	Fraction	0.19

Element name	Average Temperature	Reactive	Percent removal	Blanket fraction
Intermediate Clarifier	Uses global setting	No	65.00	0.05
Final Clarifier	Uses global setting	No	99.45	0.05

Configuration information for all COD Influent units

Operating data Average (flow/time weighted as required)

Element name	Influent (P2)	Influent (P1)
Time	0	0
Flow	10.18	22.95
Total COD mgCOD/L	555.00	680.00
Total Kjeldahl Nitrogen mgN/L	34.30	33.70
Total P mgP/L	6.16	5.94
Nitrate N mgN/L	3.18	3.24
pH	6.91	6.71
Alkalinity mmol/L	4.00	4.00
Inorganic S.S. mgTSS/L	15.00	21.00
Calcium mg/L	80.00	80.00
Magnesium mg/L	15.00	15.00
Dissolved oxygen mg/L	0	0

Element name	Influent (P2)	Influent (P1)
Fbs - Readily biodegradable (including Acetate) [gCOD/g of total COD]	0.1600	0.1600
Fac - Acetate [gCOD/g of readily biodegradable COD]	0.1500	0.1500
Fxsp - Non-colloidal slowly biodegradable [gCOD/g of slowly degradable COD]	0.7500	0.7500
Fus - Unbiodegradable soluble [gCOD/g of total COD]	0.0500	0.0500
Fup - Unbiodegradable particulate [gCOD/g of total COD]	0.1300	0.1300
Fna - Ammonia [gNH3-N/gTKN]	0.7500	0.7500
Fnox - Particulate organic nitrogen [gN/g Organic N]	0.5000	0.5000
Fnus - Soluble unbiodegradable TKN [gN/gTKN]	0.0200	0.0200
FupN - N:COD ratio for unbiodegradable part. COD [gN/gCOD]	0.0350	0.0350
Fpo4 - Phosphate [gPO4-P/gTP]	0.5000	0.5000
FupP - P:COD ratio for influent unbiodegradable part. COD [gP/gCOD]	0.0110	0.0110
FZbh - Non-poly-P heterotrophs [gCOD/g of total COD]	0.0001	0.0001

FZbm - Anoxic methanol utilizers [gCOD/g of total COD]	0.0001	0.0001
FZaob - Ammonia oxidizers [gCOD/g of total COD]	0.0001	0.0001
FZnob - Nitrite oxidizers [gCOD/g of total COD]	0.0001	0.0001
FZamob - Anaerobic ammonia oxidizers [gCOD/g of total COD]	0.0001	0.0001
FZbp - PAOs [gCOD/g of total COD]	0.0001	0.0001
FZbpa - Propionic acetogens [gCOD/g of total COD]	0.0001	0.0001
FZbam - Acetoclastic methanogens [gCOD/g of total COD]	0.0001	0.0001
FZbhm - H2-utilizing methanogens [gCOD/g of total COD]	0.0001	0.0001

Configuration information for all Media Bioreactor units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]	# of diffusers
TF1-Layer 2	3.1961	251328.0000	1.7	56949
TF1-Layer 3	3.1961	251328.0000	1.7	56949
TF1-Layer 4	3.1961	251328.0000	1.7	56949
TF1-Layer 1	3.1961	251328.0000	1.7	56949

Element name	Specific area [ft2/ft3]	Specific volume [ft3/ft3]	% of reactor filled with media [%]
TF1-Layer 2	15.24	0.75	100.00
TF1-Layer 3	15.24	0.75	100.00
TF1-Layer 4	15.24	0.75	100.00
TF1-Layer 1	15.24	0.75	100.00

Operating data Average (flow/time weighted as required)

Element name	Average DO Setpoint
TF1-Layer 2	0.5
TF1-Layer 3	0.8
TF1-Layer 4	0.8
TF1-Layer 1	0.3

Aeration equipment parameters

Element name	k1 in C = k1(PC)^0.25 + k2	k2 in C = k1(PC)^0.25 + k2	Y in Kla = C Usg ^ Y - Usg in [m3/(m2 d)]	Area of one diffuser	% of tank area covered by diffusers [%]
TF1-Layer 2	2.5656	0.0432	0.8200	0.0410	10.0000
TF1-Layer 3	2.5656	0.0432	0.8200	0.0410	10.0000
TF1-Layer 4	2.5656	0.0432	0.8200	0.0410	10.0000
TF1-Layer 1	2.5656	0.0432	0.8200	0.0410	10.0000

Configuration information for all Sidestream Mixer units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]
SD1	0	N/A	N/A
FDB	0	N/A	N/A
MSDB	0	N/A	N/A
SD4	0	N/A	N/A
SD2	0	N/A	N/A
SD3	0	N/A	N/A
InfPS-A	0	N/A	N/A
InfPS-B	0	N/A	N/A

Configuration information for all Ideal primary settling tank units

Physical data

Element name	Volume [Mil. Gal]	Area [ft2]	Depth [ft]
Primary Clarifier (P2)	3.4264	25447.0000	18.0
Primary Clarifier (P1)	4.4442	33006.0000	18.0

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
Primary Clarifier (P2)	Fraction	0.03
Primary Clarifier (P1)	Fraction	0.03

Element name	Percent removal	Blanket fraction
Primary Clarifier (P2)	63.00	0.10
Primary Clarifier (P1)	63.00	0.10

Configuration information for all Dewatering unit units

Physical data

Element name	No Volume
BFP	0
DAF	0

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
BFP	Fraction	0.15
DAF	Fraction	0.20

Element name	Percent removal
BFP	93.00
DAF	75.00

Configuration information for all Sludge units

Configuration information for all Splitter units

Physical data

Element name	Volume[Mil. Gal]	Area[ft2]	Depth[ft]
RAS/WAS Splitter	0	N/A	N/A
TF Recycle	0	N/A	N/A

Operating data Average (flow/time weighted as required)

Element name	Split method	Average Split specification
RAS/WAS Splitter	Fraction	0.95
TF Recycle	Ratio	1.00

BioWin Album

Album page - Tables

Elements	Flow [mgd]	Total COD [mg/L]	Total Carbonaceous BOD [mg/L]	Total suspended solids [mgTSS/L]	Ammonia N [mgN/L]	Nitrate N [mgN/L]	Nitrite N [mgN/L]	Total Kjeldahl Nitrogen [mgN/L]	Total N [mgN/L]	Total P [mgP/L]	Alkalinity [mmol/L]	pH []	Dissolved oxygen [mg/L]
Influent (P1)	22.95	680.00	334.04	286.83	25.27	3.24	0	33.70	36.94	5.94	4.00	6.71	0
Primary Clarifier (P1)	22.38	416.19	223.56	108.85	25.27	3.24	0	30.32	33.56	4.10	4.00	6.70	0
InfPS-A	11.20	1926.24	850.95	1189.86	25.61	2.89	0.00	68.13	71.02	19.54	4.01	6.93	0.07
InfPS-B	11.77	2366.85	1035.72	1484.08	25.59	2.91	0.00	72.87	75.78	22.38	4.01	6.91	0.07
Influent (P2)	10.18	555.00	272.64	231.96	25.73	3.18	0	34.30	37.48	6.16	4.00	6.91	0
Primary Clarifier (P2)	11.48	1022.34	468.26	563.19	25.59	2.91	0.00	45.51	48.41	10.46	4.01	6.91	0.07
SD1	33.86	621.73	306.54	262.91	25.38	3.13	0.00	35.47	38.60	6.25	4.00	6.76	0.02
SD2	67.38	420.60	201.23	175.91	24.91	1.57	0.00	32.33	33.91	5.81	4.09	6.95	0.38

SD3	67.96	487.34	228.33	223.01	24.79	1.67	0.00	34.00	35.66	6.51	4.07	6.95	0.38
SD4	68.08	491.78	228.70	226.64	25.64	1.66	0.00	35.04	36.71	7.57	4.10	6.95	0.38
TF1-Layer 1	68.08	480.04	218.94	232.42	25.50	0.27	0.04	35.01	35.31	7.57	4.19	7.15	0.25
TF1-Layer 2	68.08	469.74	210.30	237.68	25.25	0.04	0.01	34.95	35.00	7.57	4.19	7.23	0.50
TF1-Layer 3	68.08	458.55	201.09	243.20	24.86	0.01	0.00	34.88	34.89	7.57	4.18	7.23	0.75
TF1-Layer 4	68.08	448.18	192.72	247.83	24.44	0.00	0.00	34.81	34.81	7.57	4.17	7.25	0.75
Intermediate Clarifier	67.06	217.50	94.90	88.06	24.44	0.00	0.00	29.16	29.17	5.36	4.17	7.25	0.75
TF Recycle	33.53	217.50	94.90	88.06	24.44	0.00	0.00	29.16	29.17	5.36	4.17	7.25	0.75
FDB	40.87	1382.22	474.21	1013.34	20.11	3.52	0.05	96.73	100.30	27.87	3.62	7.11	0.75
AB1-1	40.87	1349.10	448.61	1024.94	8.06	9.59	3.14	86.92	99.65	27.87	2.14	6.63	0.75
AB1-2	40.87	1306.48	421.99	1000.33	0.35	19.60	0.25	79.09	98.94	27.87	1.07	6.33	0.75
Final Clarifier	33.11	41.91	3.69	6.79	0.35	19.60	0.25	2.62	22.48	3.77	1.07	6.33	0.75
Effluent	33.11	41.91	3.69	6.79	0.35	19.60	0.25	2.62	22.48	3.77	1.07	6.33	0.75
RAS/ WAS Splitter	0.42	6697.53	2205.23	5235.92	0.35	19.60	0.25	405.08	424.93	130.62	1.07	6.33	0.75
MSDB	0.71	26537.60	10850.35	18500.90	10.76	12.72	0.15	708.16	721.03	277.72	2.28	6.66	0.47
DAF	0.57	8363.17	3425.44	5781.53	10.76	12.72	0.15	230.31	243.17	89.14	2.28	6.66	0.47
Anaerobic Digester	0.14	34782.42	4613.65	27389.77	501.70	0.00	0.00	1937.78	1937.78	1032.02	20.16	7.09	0.00

BFP	0.12	2979.34	440.28	2255.63	501.70	0.00	0.00	621.38	621.38	603.36	20.10	7.15	0.00
Dewatered Sludge	0.02	214999.85	28262.72	169816.60	501.70	0.00	0.00	9397.41	9397.41	3461.10	20.10	7.15	0.00

Global Parameters

AOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.90000	0.90000	1.0720
Substrate (NH4) half sat. [mgN/L]	0.70000	0.70000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiHNO2 [mmol/L]	0.00500	0.00500	1.0000

NOB

Name	Default	Value	
Max. spec. growth rate [1/d]	0.70000	0.70000	1.0600
Substrate (NO2) half sat. [mgN/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.17000	0.17000	1.0290
Anoxic/anaerobic decay rate [1/d]	0.08000	0.08000	1.0290
KiNH3 [mmol/L]	0.07500	0.07500	1.0000

ANAMMOX

Name	Default	Value	
Max. spec. growth rate [1/d]	0.10000	0.10000	1.1000
Substrate (NH4) half sat. [mgN/L]	2.00000	2.00000	1.0000
Substrate (NO2) half sat. [mgN/L]	1.00000	1.00000	1.0000
Aerobic decay rate [1/d]	0.01900	0.01900	1.0290
Anoxic/anaerobic decay rate [1/d]	0.00950	0.00950	1.0290
Ki Nitrite [mgN/L]	1000.00000	1000.00000	1.0000

Nitrite sensitivity constant [L / (d mgN)]	0.01600	0.01600	1.0000

OHOs

Name	Default	Value	
Max. spec. growth rate [1/d]	3.20000	3.20000	1.0290
Substrate half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anoxic growth factor [-]	0.50000	0.50000	1.0000
Aerobic decay [1/d]	0.62000	0.62000	1.0290
Anoxic/anaerobic decay [1/d]	0.30000	0.30000	1.0290
Hydrolysis rate (AS) [1/d]	2.10000	2.10000	1.0290
Hydrolysis half sat. (AS) [-]	0.06000	0.06000	1.0000
Anoxic hydrolysis factor [-]	0.28000	0.28000	1.0000
Anaerobic hydrolysis factor [-]	0.50000	0.50000	1.0000
Adsorption rate of colloids [L/(mgCOD d)]	0.80000	0.80000	1.0290
Ammonification rate [L/(mgN d)]	0.04000	0.04000	1.0290
Assimilative nitrate/nitrite reduction rate [1/d]	0.50000	0.50000	1.0000
Fermentation rate [1/d]	3.20000	3.20000	1.0290
Fermentation half sat. [mgCOD/L]	5.00000	5.00000	1.0000
Anaerobic growth factor (AS) [-]	0.12500	0.12500	1.0000
Hydrolysis rate (AD) [1/d]	0.10000	0.10000	1.0500
Hydrolysis half sat. (AD) [mgCOD/L]	0.15000	0.15000	1.0000

Methylotrophs

Name	Default	Value	
Max. spec. growth rate of methanol utilizers [1/d]	1.30000	1.30000	1.0720
Methanol half sat. [mgCOD/L]	0.50000	0.50000	1.0000
Aerobic decay rate of methanol utilizers [1/d]	0.04000	0.04000	1.0290
Anoxic/anaerobic decay rate of methanol utilizers [1/d]	0.03000	0.03000	1.0290

PAOs

Name	Default	Value	
Max. spec. growth rate [1/d]	0.95000	0.95000	1.0000
Max. spec. growth rate, P-limited [1/d]	0.42000	0.42000	1.0000
Substrate half sat. [mgCOD(PHB)/mgCOD(Zbp)]	0.10000	0.10000	1.0000
Substrate half sat., P-limited [mgCOD(PHB)/mgCOD(Zbp)]	0.05000	0.05000	1.0000
Magnesium half sat. [mgMg/L]	0.10000	0.10000	1.0000
Cation half sat. [mmol/L]	0.10000	0.10000	1.0000
Calcium half sat. [mgCa/L]	0.10000	0.10000	1.0000
Aerobic decay rate [1/d]	0.10000	0.10000	1.0000
Anaerobic decay rate [1/d]	0.04000	0.04000	1.0000
Sequestration rate [1/d]	6.00000	6.00000	1.0000
Anoxic growth factor NO3 [-]	0.33000	0.33000	1.0000
Anoxic growth factor NO2 [-]	0.33000	0.33000	1.0000

Acetogens

Name	Default	Value	
Max. spec. growth rate [1/d]	0.25000	0.25000	1.0290
Substrate half sat. [mgCOD/L]	10.00000	10.00000	1.0000
Acetate inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Decay rate [1/d]	0.05000	0.05000	1.0290
Aerobic decay rate [1/d]	0.52000	0.52000	1.0290

Methanogens

Name	Default	Value	
Acetoclastic Mu Max [1/d]	0.30000	0.30000	1.0290
H2-utilizing Mu Max [1/d]	1.40000	1.40000	1.0290
Acetoclastic Ks [mgCOD/L]	100.00000	100.00000	1.0000
Acetoclastic methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
H2-utilizing CO2 half sat. [mmol/L]	0.10000	0.10000	1.0000
H2-utilizing Ks [mgCOD/L]	0.10000	0.10000	1.0000

H2-utilizing methanol Ks [mgCOD/L]	0.50000	0.50000	1.0000
Acetoclastic propionic inhibition [mgCOD/L]	10000.00000	10000.00000	1.0000
Acetoclastic decay rate [1/d]	0.13000	0.13000	1.0290
Acetoclastic aerobic decay rate [1/d]	0.60000	0.60000	1.0290
H2-utilizing decay rate [1/d]	0.13000	0.13000	1.0290
H2-utilizing aerobic decay rate [1/d]	0.60000	0.60000	1.0290

pH

Name	Default	Value
Heterotrophs low pH limit [-]	4.00000	4.00000
Heterotrophs high pH limit [-]	10.00000	10.00000
Methanol utilizers low pH limit [-]	4.00000	4.00000
Methanol utilizers high pH limit [-]	10.00000	10.00000
Autotrophs low pH limit [-]	5.50000	5.50000
Autotrophs high pH limit [-]	9.50000	9.50000
PolyP heterotrophs low pH limit [-]	4.00000	4.00000
Poly P heterotrophs high pH limit [-]	10.00000	10.00000
Heterotrophs low pH limit (anaerobic) [-]	5.50000	5.50000
Heterotrophs high pH limit (anaerobic) [-]	8.50000	8.50000
Propionic acetogens low pH limit [-]	4.00000	4.00000
Propionic acetogens high pH limit [-]	10.00000	10.00000
Acetoclastic methanogens low pH limit [-]	5.00000	5.00000
Acetoclastic methanogens high pH limit [-]	9.00000	9.00000
H2-utilizing methanogens low pH limit [-]	5.00000	5.00000
H2-utilizing methanogens high pH limit [-]	9.00000	9.00000

Switches

Name	Default	Value
Heterotrophic DO half sat. [mgO2/L]	0.05000	0.05000
Aerobic denit. DO half sat. [mgO2/L]	0.05000	0.05000

Ammonia oxidizer DO half sat. [mgO2/L]	0.25000	0.25000
Nitrite oxidizer DO half sat. [mgO2/L]	0.50000	0.50000
Anaerobic ammonia oxidizer DO half sat. [mgO2/L]	0.01000	0.01000
Anoxic NO3 half sat. [mgN/L]	0.10000	0.10000
Anoxic NO2 half sat. (mgN/L)	0.05000	0.05000
NH3 nutrient half sat. [mgN/L]	1.0000E-4	1.0000E-4
PolyP half sat. [mgP/L]	0.01000	0.01000
VFA sequestration half sat. [mgCOD/L]	5.00000	5.00000
P uptake half sat. [mgP/L]	0.15000	0.15000
P nutrient half sat. [mgP/L]	0.00100	0.00100
Autotroph CO2 half sat. [mmol/L]	0.10000	0.10000
Heterotrophic Hydrogen half sat. [mgCOD/L]	1.00000	1.00000
Propionic acetogens Hydrogen half sat. [mgCOD/L]	5.00000	5.00000
Synthesis anion/cation half sat. [meq/L]	0.01000	0.01000

AOB

Name	Default	Value
Yield [mgCOD/mgN]	0.15000	0.15000
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
P in inert [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

NOB

Name	Default	Value
Yield [mgCOD/mgN]	0.09000	0.09000
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in inert [mgN/mgCOD]	0.07000	0.07000

P in biomass [mgP/mgCOD]	0.02200	0.02200
P in inert [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

ANAMMOX

Name	Default	Value
Yield [mgCOD/mgN]	0.11400	0.11400
Nitrate production [mgN/mgBiomassCOD]	2.28000	2.28000
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
P in inert [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

OHOs

Name	Default	Value
Yield (aerobic) [-]	0.66600	0.66600
Yield (fermentation, low H2) [-]	0.10000	0.10000
Yield (fermentation, high H2) [-]	0.10000	0.10000
H2 yield (fermentation low H2) [-]	0.35000	0.35000
H2 yield (fermentation high H2) [-]	0	0
Propionate yield (fermentation, low H2) [-]	0	0
Propionate yield (fermentation, high H2) [-]	0.70000	0.70000
CO2 yield (fermentation, low H2) [-]	0.70000	0.70000
CO2 yield (fermentation, high H2) [-]	0	0
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200

P in inert [mgP/mgCOD]	0.02200	0.02200
Endogenous Residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield (anoxic) [-]	0.54000	0.54000
Yield propionic (aerobic) [-]	0.50000	0.50000
Yield propionic (anoxic) [-]	0.41000	0.41000
Yield acetic (aerobic) [-]	0.40000	0.40000
Yield acetic (anoxic) [-]	0.32000	0.32000
Yield methanol (aerobic) [-]	0.50000	0.50000
Adsorp. max. [-]	1.00000	1.00000

Methylotrophs

Name	Default	Value
Yield (anoxic) [-]	0.40000	0.40000
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
P in inert [mgP/mgCOD]	0.02200	0.02200
Endogenous Residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

PAOs

Name	Default	Value
Yield (aerobic) [-]	0.63900	0.63900
Yield (anoxic) [-]	0.52000	0.52000
Aerobic P/PHA uptake [mgP/mgCOD]	0.95000	0.95000
Anoxic P/PHA uptake [mgP/mgCOD]	0.35000	0.35000
Yield of PHA on sequestration [-]	0.88900	0.88900
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in part. inert [mgN/mgCOD]	0.07000	0.07000

N in sol. inert [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
P in part. inert [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous part. [-]	0.25000	0.25000
Inert fraction of endogenous sol. [-]	0.20000	0.20000
P/Ac release ratio [mgP/mgCOD]	0.49000	0.49000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
Yield of low PP [-]	0.94000	0.94000

Acetogens

Name	Default	Value
Yield [-]	0.10000	0.10000
H2 yield [-]	0.40000	0.40000
CO2 yield [-]	1.00000	1.00000
N in biomass [mgN/mgCOD]	0.07000	0.07000
N in endogenous residue [mgN/mgCOD]	0.07000	0.07000
P in biomass [mgP/mgCOD]	0.02200	0.02200
P in endogenous residue [mgP/mgCOD]	0.02200	0.02200
Fraction to endogenous residue [-]	0.08000	0.08000
COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

Methanogens

Name	Default	Value
Acetoclastic yield [-]	0.10000	0.10000
Methanol acetoclastic yield [-]	0.10000	0.10000
H2-utilizing yield [-]	0.10000	0.10000
Methanol H2-utilizing yield [-]	0.10000	0.10000
N in acetoclastic biomass [mgN/mgCOD]	0.07000	0.07000
N in H2-utilizing biomass [mgN/mgCOD]	0.07000	0.07000
N in acetoclastic endog. residue [mgN/mgCOD]	0.07000	0.07000

N in H2-utilizing endog. residue [mgN/mgCOD]	0.07000	0.07000
P in acetoclastic biomass [mgP/mgCOD]	0.02200	0.02200
P in H2-utilizing biomass [mgP/mgCOD]	0.02200	0.02200
P in acetoclastic endog. residue [mgP/mgCOD]	0.02200	0.02200
P in H2-utilizing endog. residue [mgP/mgCOD]	0.02200	0.02200
Acetoclastic fraction to endog. residue [-]	0.08000	0.08000
H2-utilizing fraction to endog. residue [-]	0.08000	0.08000
Acetoclastic COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000
H2-utilizing COD:VSS ratio [mgCOD/mgVSS]	1.42000	1.42000

General

Name	Default	Value
Particulate substrate COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000
Particulate inert COD:VSS ratio [mgCOD/mgVSS]	1.60000	1.60000
Ash content of biomass (synthesis ISS) [%]	8.00000	8.00000
Molecular weight of other anions [mg/mmol]	35.50000	35.50000
Molecular weight of other cations [mg/mmol]	39.10000	39.10000
Mg to P mole ratio in polyphosphate [mmolMg/mmolP]	0.30000	0.30000
Cation to P mole ratio in polyphosphate [meq/mmolP]	0.30000	0.30000
Ca to P mole ratio in polyphosphate [mmolCa/mmolP]	0.05000	0.05000
Cation to P mole ratio in organic phosphate [meq/mmolP]	0.01000	0.01000
Bubble rise velocity (anaerobic digester) [cm/s]	23.90000	23.90000
Bubble Sauter mean diameter (anaerobic digester) [cm]	0.35000	0.35000
Anaerobic digester gas hold-up factor []	1.00000	1.00000
Tank head loss per metre of length (from flow) [m/m]	0.00250	0.00250
Minimum air flow (per unit volume) without mixing [m3/(m3 d)]	1.00000	1.00000

Mass transfer

Name	Default	Value	
Kl for H2 [m/d]	17.00000	17.00000	1.0240

Kl for CO2 [m/d]	10.00000	10.00000	1.0240
Kl for NH3 [m/d]	1.00000	1.00000	1.0240
Kl for CH4 [m/d]	8.00000	8.00000	1.0240
Kl for N2 [m/d]	15.00000	15.00000	1.0240
Kl for O2 [m/d]	13.00000	13.00000	1.0240

Physico-chemical rates

Name	Default	Value	
Struvite precipitation rate [1/d]	3.0000E+10	3.0000E+10	1.0240
Struvite redissolution rate [1/d]	3.0000E+11	3.0000E+11	1.0240
Struvite half sat. [mgTSS/L]	1.00000	1.00000	1.0000
HDP precipitation rate [L/(molP d)]	1.0000E+8	1.0000E+8	1.0000
HDP redissolution rate [L/(mol P d)]	1.0000E+8	1.0000E+8	1.0000
HAP precipitation rate [molHDP/(L d)]	5.0000E-4	5.0000E-4	1.0000

Physico-chemical constants

Name	Default	Value
Struvite solubility constant [mol/L]	6.9180E-14	6.9180E-14
HDP solubility product [mol/L]	2.7500E-22	2.7500E-22
HDP half sat. [mgTSS/L]	1.00000	1.00000
Equilibrium soluble PO4 with Al dosing at pH 7 [mgP/L]	0.01000	0.01000
Al to P ratio [molAl/molP]	0.80000	0.80000
Al(OH)3 solubility product [mol/L]	1.2590E+9	1.2590E+9
AlHPO4+ dissociation constant [mol/L]	7.9430E-13	7.9430E-13
Equilibrium soluble PO4 with Fe dosing at pH 7 [mgP/L]	0.01000	0.01000
Fe to P ratio [molFe/molP]	1.60000	1.60000
Fe(OH)3 solubility product [mol/L]	0.05000	0.05000
FeH2PO4++ dissociation constant [mol/L]	5.0120E-22	5.0120E-22

Aeration

Name	Default	Value
Alpha (surf) OR Alpha F (diff) [-]	0.50000	0.50000
Beta [-]	0.95000	0.95000
Surface pressure [kPa]	101.32500	101.32500
Fractional effective saturation depth (Fed) [-]	0.32500	0.32500
Supply gas CO2 content [vol. %]	0.03500	0.03500
Supply gas O2 [vol. %]	20.95000	20.95000
Off-gas CO2 [vol. %]	2.00000	2.00000
Off-gas O2 [vol. %]	18.80000	18.80000
Off-gas H2 [vol. %]	0	0
Off-gas NH3 [vol. %]	0	0
Off-gas CH4 [vol. %]	0	0
Surface turbulence factor [-]	2.00000	2.00000
Set point controller gain []	1.00000	1.00000

Modified Vesilind

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.3873	0.3873
Vesilind hindered zone settling parameter (K) [L/g]	0.3700	0.3700
Clarification switching function [mg/L]	100.0000	100.0000
Specified TSS conc.for height calc. [mg/L]	2500.0000	2500.0000
Maximum compactability constant [mg/L]	15000.0000	15000.0000

Double exponential

Name	Default	Value
Maximum Vesilind settling velocity (Vo) [ft/min]	0.9341	0.9341
Maximum (practical) settling velocity (Vo') [ft/min]	0.6152	0.6152
Hindered zone settling parameter (Kh) [L/g]	0.4000	0.4000
Flocculent zone settling parameter (Kf) [L/g]	2.5000	2.5000
Maximum non-settleable TSS [mg/L]	20.0000	20.0000

Non-settleable fraction [-]	0.0010	0.0010
Specified TSS conc. for height calc. [mg/L]	2500.0000	2500.0000

Biofilm general

Name	Default	Value
Attachment rate [g / (m2 d)]	80.00000	80.00000
Attachment TSS half sat. [mg/L]	100.00000	100.00000
Detachment rate [g/(m3 d)]	8.0000E+4	8.0000E+4
Solids movement factor []	10.00000	10.00000
Diffusion neta []	0.80000	0.80000
Thin film limit [mm]	0.50000	0.50000
Thick film limit [mm]	3.00000	3.00000
Assumed Film thickness for tank volume correction [mm]	0.75000	0.75000
Film surface area to media area ratio - Max.[ ]	1.00000	1.00000
Minimum biofilm conc. for streamer formation [gTSS/m2]	4.00000	4.00000

Maximum biofilm concentrations [mg/L]

Name	Default	Value	
Non-polyP heterotrophs	5.0000E+4	2.5000E+5	1.0000
Anoxic methanol utilizers	5.0000E+4	2.5000E+5	1.0000
Ammonia oxidizing biomass	1.0000E+5	5.0000E+5	1.0000
Nitrite oxidizing biomass	1.0000E+5	5.0000E+5	1.0000
Anaerobic ammonia oxidizers	5.0000E+4	2.5000E+5	1.0000
PolyP heterotrophs	5.0000E+4	2.5000E+5	1.0000
Propionic acetogens	5.0000E+4	2.5000E+5	1.0000
Acetoclastic methanogens	5.0000E+4	2.5000E+5	1.0000
Hydrogenotrophic methanogens	5.0000E+4	2.5000E+5	1.0000
Endogenous products	3.0000E+4	1.5000E+5	1.0000
Slowly bio. COD (part.)	5000.00000	2.5000E+4	1.0000
Slowly bio. COD (colloid.)	0	0	1.0000

Part. inert. COD	5000.00000	2.5000E+4	1.0000
Part. bio. org. N	0	0	1.0000
Part. bio. org. P	0	0	1.0000
Part. inert N	0	0	1.0000
Part. inert P	0	0	1.0000
Stored PHA	5000.00000	2.5000E+4	1.0000
Releasable stored polyP	1.1500E+6	5.7500E+6	1.0000
Fixed stored polyP	1.1500E+6	5.7500E+6	1.0000
PolyP bound cations	1.1500E+6	5.7500E+6	1.0000
Readily bio. COD (complex)	0	0	1.0000
Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved methane	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000
Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved nitrogen gas	0	0	1.0000
PO4-P (Sol. & Me Complexed)	1.0000E+10	5.0000E+10	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
Inorganic S.S.	1.3000E+6	6.5000E+6	1.0000
Struvite	8.5000E+5	4.2500E+6	1.0000
Hydroxy-dicalcium-phosphate	1.1500E+6	5.7500E+6	1.0000
Hydroxy-apatite	1.6000E+6	8.0000E+6	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.0000E+10	5.0000E+10	1.0000
Other Cations (strong bases)	0	0	1.0000

Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000
User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	5.0000E+4	2.5000E+5	1.0000
User defined 4	5.0000E+4	2.5000E+5	1.0000
Dissolved oxygen	0	0	1.0000

Effective diffusivities [m2/s]

Name	Default	Value	
Non-polyP heterotrophs	5.0000E-14	5.0000E-14	1.0290
Anoxic methanol utilizers	5.0000E-14	5.0000E-14	1.0290
Ammonia oxidizing biomass	5.0000E-14	5.0000E-14	1.0290
Nitrite oxidizing biomass	5.0000E-14	5.0000E-14	1.0290
Anaerobic ammonia oxidizers	5.0000E-14	5.0000E-14	1.0290
PolyP heterotrophs	5.0000E-14	5.0000E-14	1.0290
Propionic acetogens	5.0000E-14	5.0000E-14	1.0290
Acetoclastic methanogens	5.0000E-14	5.0000E-14	1.0290
Hydrogenotrophic methanogens	5.0000E-14	5.0000E-14	1.0290
Endogenous products	5.0000E-14	5.0000E-14	1.0290
Slowly bio. COD (part.)	5.0000E-14	5.0000E-14	1.0290
Slowly bio. COD (colloid.)	6.9000E-11	6.9000E-11	1.0290
Part. inert. COD	5.0000E-14	5.0000E-14	1.0290
Part. bio. org. N	5.0000E-14	5.0000E-14	1.0290
Part. bio. org. P	5.0000E-14	5.0000E-14	1.0290
Part. inert N	5.0000E-14	5.0000E-14	1.0290
Part. inert P	5.0000E-14	5.0000E-14	1.0290
Stored PHA	5.0000E-14	5.0000E-14	1.0290
Releasable stored polyP	5.0000E-14	5.0000E-14	1.0290
Fixed stored polyP	5.0000E-14	5.0000E-14	1.0290

PolyP bound cations	5.0000E-14	5.0000E-14	1.0290
Readily bio. COD (complex)	6.9000E-10	6.9000E-10	1.0290
Acetate	1.2400E-9	1.2400E-9	1.0290
Propionate	8.3000E-10	8.3000E-10	1.0290
Methanol	1.6000E-9	1.6000E-9	1.0290
Dissolved H2	5.8500E-9	5.8500E-9	1.0290
Dissolved methane	1.9625E-9	1.9625E-9	1.0290
Ammonia N	2.0000E-9	2.0000E-9	1.0290
Sol. bio. org. N	1.3700E-9	1.3700E-9	1.0290
Nitrite N	2.9800E-9	2.9800E-9	1.0290
Nitrate N	2.9800E-9	2.9800E-9	1.0290
Dissolved nitrogen gas	1.9000E-9	1.9000E-9	1.0290
PO4-P (Sol. & Me Complexed)	2.0000E-9	2.0000E-9	1.0290
Sol. inert COD	6.9000E-10	6.9000E-10	1.0290
Sol. inert TKN	6.8500E-10	6.8500E-10	1.0290
Inorganic S.S.	5.0000E-14	5.0000E-14	1.0290
Struvite	5.0000E-14	5.0000E-14	1.0290
Hydroxy-dicalcium-phosphate	5.0000E-14	5.0000E-14	1.0290
Hydroxy-apatite	5.0000E-14	5.0000E-14	1.0290
Magnesium	7.2000E-10	7.2000E-10	1.0290
Calcium	7.2000E-10	7.2000E-10	1.0290
Metal	4.8000E-10	4.8000E-10	1.0290
Other Cations (strong bases)	1.4400E-9	1.4400E-9	1.0290
Other Anions (strong acids)	1.4400E-9	1.4400E-9	1.0290
Total CO2	1.9600E-9	1.9600E-9	1.0290
User defined 1	6.9000E-10	6.9000E-10	1.0290
User defined 2	6.9000E-10	6.9000E-10	1.0290
User defined 3	5.0000E-14	5.0000E-14	1.0290
User defined 4	5.0000E-14	5.0000E-14	1.0290
Dissolved oxygen	2.5000E-9	2.5000E-9	1.0290

EPS Strength coefficients [ ]

Name	Default	Value	
Non-polyP heterotrophs	1.00000	1.00000	1.0000
Anoxic methanol utilizers	1.00000	1.00000	1.0000
Ammonia oxidizing biomass	1.00000	1.00000	1.0000
Nitrite oxidizing biomass	1.00000	1.00000	1.0000
Anaerobic ammonia oxidizers	1.00000	1.00000	1.0000
PolyP heterotrophs	1.00000	1.00000	1.0000
Propionic acetogens	1.00000	1.00000	1.0000
Acetoclastic methanogens	1.00000	1.00000	1.0000
Hydrogenotrophic methanogens	1.00000	1.00000	1.0000
Endogenous products	1.00000	1.00000	1.0000
Slowly bio. COD (part.)	1.00000	1.00000	1.0000
Slowly bio. COD (colloid.)	0	0	1.0000
Part. inert. COD	1.00000	1.00000	1.0000
Part. bio. org. N	1.00000	1.00000	1.0000
Part. bio. org. P	1.00000	1.00000	1.0000
Part. inert N	1.00000	1.00000	1.0000
Part. inert P	1.00000	1.00000	1.0000
Stored PHA	1.00000	1.00000	1.0000
Releasable stored polyP	1.00000	1.00000	1.0000
Fixed stored polyP	1.00000	1.00000	1.0000
PolyP bound cations	1.00000	1.00000	1.0000
Readily bio. COD (complex)	0	0	1.0000
Acetate	0	0	1.0000
Propionate	0	0	1.0000
Methanol	0	0	1.0000
Dissolved H2	0	0	1.0000
Dissolved methane	0	0	1.0000
Ammonia N	0	0	1.0000
Sol. bio. org. N	0	0	1.0000

Nitrite N	0	0	1.0000
Nitrate N	0	0	1.0000
Dissolved nitrogen gas	0	0	1.0000
PO4-P (Sol. & Me Complexed)	1.00000	1.00000	1.0000
Sol. inert COD	0	0	1.0000
Sol. inert TKN	0	0	1.0000
Inorganic S.S.	0.33000	0.33000	1.0000
Struvite	1.00000	1.00000	1.0000
Hydroxy-dicalcium-phosphate	1.00000	1.00000	1.0000
Hydroxy-apatite	1.00000	1.00000	1.0000
Magnesium	0	0	1.0000
Calcium	0	0	1.0000
Metal	1.00000	1.00000	1.0000
Other Cations (strong bases)	0	0	1.0000
Other Anions (strong acids)	0	0	1.0000
Total CO2	0	0	1.0000
User defined 1	0	0	1.0000
User defined 2	0	0	1.0000
User defined 3	1.00000	1.00000	1.0000
User defined 4	1.00000	1.00000	1.0000
Dissolved oxygen	0	0	1.0000

Wichita Wastewater Treatment Plant No.2 Nutrient Loading Evaluation
PEC PROJECT NO. 34-08198-0042

Cost Evaluation - WWTP
OPINION OF COST
Date 2/6/09

Alkalinity Feed Improvements

Chemical Feed

QUANTITY		DESCRIPTION	UNIT PRICE		INSTALLATION	AMOUNT	TOTAL
1	LS	Electrical Connections/Controls	$10,000	LS	1.00	$10,000	
1	LS	Valves, Fitting	$10,000	LS	1.00	$10,000	
1	LS	Piping	$10,000	LS	1.00	$10,000	
1	LS	Caustic Soda Feed System	$100,000	LS	1.30	$130,000	
1	EA	Instrumentation	$10,000	EA	1.30	$13,000	
		SUB TOTAL					**$173,000**

Site Work

QUANTITY		DESCRIPTION	UNIT PRICE		INSTALLATION	AMOUNT	TOTAL
1	LS	Building Modifications	$50,000	LS	1.00	$50,000	
1	LS	Site Cleaning/Restoration	$20,000	LS	1.00	$20,000	
1	LS	Electrical Site Work	$20,000	LS	1.00	$20,000	
1	LS	Piping and Valves	$10,000	LS	1.00	$10,000	
1	LS	Site Drainage/Excavation	$20,000	LS	1.00	$20,000	
		SUB TOTAL					**$120,000**

CONTRACTOR COSTS

1	LS	Contractors' Fixed Costs	20.00	%	1.00	$58,600	
		SUB TOTAL					**$59,000**

		CONSTRUCTION SUB-TOTAL	**$352,000**
CONTINGENCY	**20.0%**		**$71,000**
		TOTAL CONSTRUCTION COST	**$423,000**
PROJECT COSTS	**20.0%**		**$71,000**
		TOTAL PROJECT COST	**$494,000**

Wichita Wastewater Treatment Plant No.2 Nutrient Loading Evaluation
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Cost Evaluation - WWTP
OPINION OF COST
Date 2/6/09

Alkalinity Feed Improvements

Chemical Feed

QUANTITY		DESCRIPTION	UNIT PRICE		INSTALLATION	AMOUNT	TOTAL
1	LS	Electrical Connections/Controls	$10,000	LS	1.00	$10,000	
1	LS	Valves, Fitting	$10,000	LS	1.00	$10,000	
1	LS	Piping	$10,000	LS	1.00	$10,000	
1	LS	Hydrated Lime Feed System	$150,000	LS	1.30	$195,000	
1	EA	Instrumentation	$10,000	EA	1.30	$13,000	
		SUB TOTAL					**$238,000**

Site Work

QUANTITY		DESCRIPTION	UNIT PRICE		INSTALLATION	AMOUNT	TOTAL
1	LS	Building Modifications	$50,000	LS	1.00	$50,000	
1	LS	Site Cleaning/Restoration	$20,000	LS	1.00	$20,000	
1	LS	Electrical Site Work	$20,000	LS	1.00	$20,000	
1	LS	Piping and Valves	$10,000	LS	1.00	$10,000	
1	LS	Site Drainage/Excavation	$20,000	LS	1.00	$20,000	
		SUB TOTAL					**$120,000**

CONTRACTOR COSTS

1	LS	Contractors' Fixed Costs	20.00	%	1.00	$71,600	
		SUB TOTAL					**$72,000**

		CONSTRUCTION SUB-TOTAL	**$430,000**
CONTINGENCY	**20.0%**		**$86,000**
		TOTAL CONSTRUCTION COST	**$516,000**
PROJECT COSTS	**20.0%**		**$86,000**
		TOTAL PROJECT COST	**$602,000**